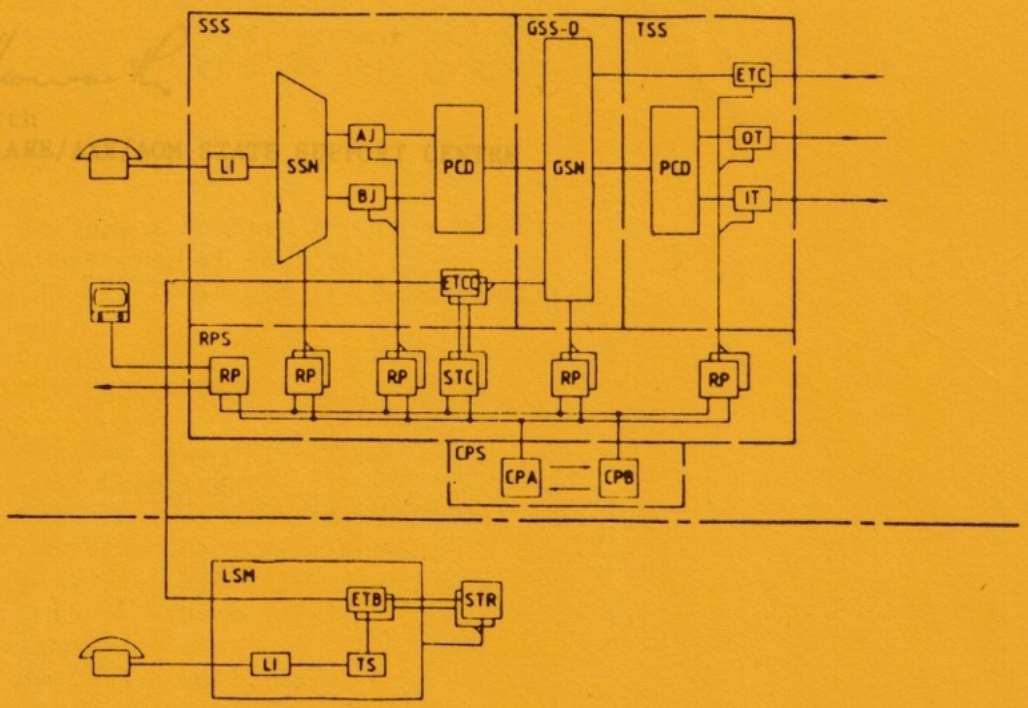
# INTRODUCTION OF AXE INTO METROPOLITAN & COUNTRY EXCHANGES

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# INTRODUCTION OF AXE INTO METROPOLITAN AND COUNTRY EXCHANGES

## FOREWORD

The introduction of the Integrated Digital Network (IDN) into the metropolitan area commenced in late 1983 with the interconnection of Batman and Windsor AXE exchanges by Pulse Code Modulated (PCM) digital transmission systems. The 1984/85 AXE projects for Morwell, Bendigo and Ballarat heralded the expansion of the IDN into the Victorian Country Network. The IDN is currently being overlaid on the existing analogue network.

This document provides an overview of the AXE switching system. It describes, in broad terms, the features and facilities of the AXE system to enable District staff to obtain an initial appreciation of the AXE system. It also includes an outline of plans for the utilisation of a Small Digital Rural AXE Exchange which is currently being developed, jointly, by Telecom and L.M. Ericsson. It is expected to be available by 1986/87.

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# THE AXE SYSTEM

## INTRODUCTION OF AXE INTO METROPOLITAN AND COUNTRY EXCHANGES

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Doc Id 0438B

# OVERVIEW OF THE AXE EXCHANGE SWITCHING SYSTEM

# 1. INTRODUCTION

## 1.1 Purpose

This Information Paper provides an overview of the AXE Local Exchange Switching System.

It describes in broad terms the features and facilities of AXE to enable District staff to obtain an initial appreciation of the AXE System.

## 1.2 The Advantages of the AXE System

- It will improve customer service

  This results from the provision of facilities which, for example, allow for remote and immediate changing of customers categories, connections, disconnections and reconnections of customers services and also for ad hoc meter readings. Streamlining of procedures in Telecom will be enhanced.

- Installed equipment costs will be considerably less

  This results from the extensive use of miniaturised components, modular packaging and comprehensive processor aids for installation.

- It costs less to run AXE exchanges

  Operation and maintenance aids, most of them computer based, are very extensive with AXE, and the system's self diagnostic programs streamline fault finding.

- It is cheaper to add system improvements and new facilities

  The modular, flexible design of the AXE system will mean that system improvements and new facilities required in future years will be added relatively simply and cheaply. Complicated re-designs and hardware modifications required with the existing equipment types will be avoided with AXE.

- It will use less floor space (about half that of crossbar)

  Telecom's capital expenditure on new buildings and extensions is extremely large. The potential saving on building costs will amount to many millions of dollars in the future, especially in high cost urban areas.

## 2. AXE SWITCHING SYSTEM

### 2.1 AXE Overview

Telephone traffic in an AXE exchange is switched under computer control. Two large computers (central processors) work in parallel to handle the complex analytical functions while up to 512 small processors (regional processors) perform the simpler repetitive tasks.

The structure of the hardware and software that make up the AXE system is highly modular. This modularity simplifies installation, maintenance and extensions.

### 2.2 AOM Overview

The AOM is a separate computer system which transfers commands and data between AXE Exchanges and Network Operations Centres (NOC's). Each AXE exchange and NOC in the area served by an AOM is connected to the AOM by data links The AOM carries out security checks on all commands input by NOC terminals to ensure that only authorised terminals can access or make changes to data in each AXE exchange.

NOC's which can be connected to the AOM in this way include :

- Exchange Maintenance Group (EMG)
- Multi-Functional District (MFD)
- District Support Centre (DSC)
- State Support Centre (SSC)
- Network Performance Analysis Centre (NPAC)
- Centralised Service Assessment Centre (CSAC)
- Fault Despatch Centre (FDC)
- Subscriber Equipment Depot (SED)
- District Office (DO)
- Traffic Engineering Centre (TEC)

### 2.3 Operational Features

All customer related data, including subscribers' meters, subscribers' classifications and the directory number associated with each equipment termination will be stored in the AXE exchange memory. This data can be read in, read out, or altered by local or remote input from an authorised terminal. These facilities enable a number of routine functions now required with electro-mechanical exchanges to be carried out remotely. The functions that may be carried out remotely include meter reading, changing of subscribers' classifications, connection and disconnection of pre-wired services, change of directory number, printout of call records, and similar functions which no longer require physical connections or re-arrangement of strappings or MDF jumpers.

## 2.4 Connection of a Customer to Local Subscriber Switching Subsystem (LSS)

Each customer is connected to the AXE exchange via the Subscriber Switching Subsystem (SSS). Where the SSS equipment is co-located with AXE group switching equipment and central processor, it is designated as an LSS (Local Switching Subsystem). Within the LSS, each customer is connected to an individual LIC. The LIC (Line Interface Circuit) provides the interface between the customer's line and the AXE exchange for speech and signal transmission.

Each LIC is identified by a unique equipment number (LI - number). This equipment number is linked with the customer's directory number in the AXE customer data. The equipment number associated with a directory number can be changed by command.

## 2.5 Connection of a Customer to Remote Subscriber Switching Subsystem (RSS-D)

The remote subscriber stage application involves the installation of a subscriber switching subsystem in a location remote from the exchange on which it is "parented". This parent exchange, called a "node", provides the group switching and central processor control facilities and is connected to the RSS-D by two or more PCM systems, depending on traffic levels. The RSS-D incorporates subscriber-line interface equipment and a concentration/expansion stage for outgoing/incoming subscriber traffic.

The RSS-D requires little floor area and it is possible to locate it in buildings accommodating other switching systems such as crossbar and step by step.

# 3. NETWORK FACILITIES

## 3.1 Equipment Number/Directory Number Translation

Each customer's line in AXE has an Equipment number which is associated with a directory number in customer's data. The equipment number associated with a directory number can be changed by command.

This facility will enable :

i traffic balancing without subscriber number changes.

ii the directory number of a service to be changed by command to any free number in the number range of the exchange without altering the physical connections.

iii minimisation of MDF jumper length and of changes to MDF jumpering.

iv a high equipment occupancy as cancelled services can immediately be reused with a different directory number, with the old directory number on interception.

## 3.2 Connection of PBX's

PBX lines can have three traffic directions

- Incoming to the PBX
- Outgoing from the PBX
- Bothway

A group of PBX lines can be sub-divided into sub-routes. A PBX group can have a maximum of 4 sub-routes with up to 100 lines in each sub-route.

Lines in a sub-route must have the same traffic direction but each sub-route can be provided with either rotary or sequential hunting. Each sub-route can be given a different hunting sequence.

. Rotary Hunting

The selection of a line (for an incoming call) is a rotary selection for incoming or bothway sub-routes.

. Sequential Hunting

Lines in incoming and bothway sub-routes are selected in a specific order. Each incoming or bothway line is given a unique hunting number starting from zero (0). An incoming call will be accepted by the line with the lowest hunting number.

A group of PBX lines will usually be associated with a common Directory (or Service) number called the "Group Number". Any line in the PBX Group can also be associated with another Directory Number for night switching purposes. The additional Directory Number is called an "Individual Number".

There is no restriction on the allocation of group and individual numbers within the number range of the exchange.

Call charging for outgoing PBX lines can be on a group basis or for each line.

. Group Call Charging

Call charges for all lines in the sub-route (including individual numbers) are charged against the Group number.

. Individual Call Charging

One, or more, lines in a sub-route can be charged individually rather than against the group number.

As Call Meters are associated with Directory numbers a PBX line must be connected to an Individual Number to gain individual Call Charging facilities.

PBX Groups are allowed any valid combination of Service Classifications. The classifications are associated with Directory Numbers or Group numbers and the classifications are provided across a full PBX Group and not for individual sub-routes within the PBX Group.

Where a subscriber requires only some lines to have a particular facility (eg, STD Barring), a separate group number and associated sub-routes would have to be provided.

## 3.3 Network Tones and Recorded Voice Announcements

To indicate to a calling subscriber that a call has failed or has been released, the subscriber's line is connected to an appropriate tone or a recorded announcement.

Where tones or recorded announcements are generated from the originating exchange the connection is released and the service placed in the line lock-out condition after the tone or recorded announcement has been fed to the subscriber's line for a period of 30 seconds. Where recorded announcement or tone is fed from the distant exchange, the time supervision periods will control the length of time the tone or recorded announcement is applied before the service is set into the line lock-out condition. Tone is not provided on services in the line lock-out condition.

The provision of a tone or RVA from AXE Exchanges is as follows :

| | | |
|---|---|---|
| i | 'B' Party Busy | - Busy Tone |
| ii | All Circuits Busy | - Congestion Tone |
| iii | Time Supervision Exceeded | - Congestion Tone |
| iv | Call to Unallotted (Vacant) Number | - RVA |
| v | Barred Codes Dialled | - RVA |
| vi | Fault Condition | - Congestion Tone |
| vii | Signalling Failure | - Congestion Tone |
| viii | Control of Easycall Services | - Facilities Tone or RVA |

Ring will always be phased individually on each call so that the start of the first "ON" pulse always coincides with the application of ring for all calls. This feature overcomes the problem of PABX originating calls seizing incoming calls during an initial "OFF" ring period.

The same exchange dial tone is used for both decadic and VF push button services.

The Facilities Tone (Easycall Tone) will be used :

- In place of Dial Tone if the Call Transfer or Don't Disturb Service is already activated.

- To indicate the successful registration or cancellation of an Easycall Service.

- To verify that the Call Transfer Facility is activated to a specific number.

A total of 8 RVA's are proposed to cater for the full range of Easycall Services outlined in Section 4.9.

## 4. CUSTOMER FACILITIES

### 4.1 Service Classifications

All services connected to an AXE exchange have a particular service Classification which will allow each service to operate within specific guidelines. A service classification consists of a combination of classification values where each classification value allows a particular facility requiring special exchange handling or processing. The required classifications are allocated by a command input from an authorised terminal.

The permitted AXE service classifications are detailed in the document "AXE Subscriber Classifications" No. AXE S020 published by the HQ AXE Project Team.

### 4.2 Call Charging

The AXE customer meters are not hardware devices, but are software counters, provided one for each customer's line. The software meter registers each successful unit fee (local) call on answer, and all meter pulses sent from the trunk exchanges on multimetered (STD and ISD-multimetered) calls.

To ensure security, the contents of the software meters are frequently dumped to cartridge tape. These meters are not reset when read from a terminal, hence there is no risk of losing charging data due to operator error during meter readings.

## 4.3 Call Revenue Statistics

The AXE system has facilities to provide call and revenue statistics to assist in the planning of tariff changes and the assessment of the effects of tariff changes.

i Local Calls

- Total number of effective local fee calls originating at the exchange.
- Total number of meter pulse registrations for local calls originating at the exchange.

ii STD/ISD Calls

- Total number of effective charged calls originating from the exchange.
- Total number of meter registrations for calls originating from the exchange.

Call revenue statistics are nominally recorded on a daily basis; however, the time may be altered by command.

Call revenue statistic counters are always reset when an exchange reload occurs.

## 4.4 Charging Check Facility

AXE provides charge check facilities to enable the investigation of metering complaints and the collection of statistical information to assess charging accuracy.

Although the charging check facilities are provided by the AXE system, the AOM is required to provide the following functions :

- Store charging check records.
- Maintain lists of subscribers marked for charging assessment by each Network Operations Centre.
- Output charging check records on command.

For each call, or call attempt, from a customer marked for charging check at the AXE exchange, the data recorded includes :

- A party number.
- B party number (digits dialled except for Speed Calling when the Stored B party number will be recorded).

- Date and time (hours, minutes and seconds) of call.
- Call meter value at the start of the call.
- The number of meter pulses registered for the connection.
- Charged party, (ie, non-metering, A party, B party).
- Chargeable time in seconds, (ie, B party answer to A party clear or to forced release or clear back time supervision period elapsed.).
- Outgoing trunk route identity.

## 4.5 Line Test Facility

Test positions have a basic service category (test position) and are used for limited line testing from Service Assistance Centres.

The SAC operator can dial the directory number of an AXE customer over the existing test access network. The operator cannot monitor the customer's line but will be returned tones indicating the state of line.

- Idle and intact (ring tone .75 on .75 off)
- Busy (busy tone)
- Out of Order (ring tone 2 sec)
- Congestion (congestion tone)
- Number unobtainable (NU tone)

## 4.6 Coin Telephone Service

The types of coin telephones connected to AXE exchanges are limited to :

- Local fee telephones (Redphone 52 AUX key control)
- STD and ISD telephones (CT3, CT3-1 and CT4).

Special classification values are used for coin telephones to allow the following :

- Change of allowable access (leased key control Redphones).
- Metering Signals

  The metering signals for CT3 telephones are supplied by 50 Hz signal. The metering registration at the exchange is different for a rented coin telephone from that of a public coin telephone.

On a rented coin telephone the metering registration at the exchange is delayed (800 to 1200 ms) to prevent a registration if a clear forward signal is received within the delay time.

4.7 Interception Facility

An Interception/Re-direction Service is provided for AXE Exchanges by means of the following subscriber categories :

a. Route Calls to an RVA (Customer Classification ICS=4)

b. Route Calls direct to 1139 Operator (Customer Classification ICS=5).

Where a service is classified as "Route Calls to RVA" calls to that service will be automatically connected to the standard Recorded Voice Announcement for Interception.

Where a service is classified "Route Calls to 1139 Operator", calls to that service will be automatically re-directed to the operator via the switched network.

4.8 Malicious Call Trace Facility

When a service is classified "Malicious Call Trace", details of a call are automatically recorded if the customer signals to the AXE exchange during the call.

The call details recorded depend on the origin of the call and whether Calling Line Identification for the 'A' Number (ie, Calling Number) is available.

The call details recorded are :

- A Party Number (if available)
- B Party Number
- A Party Classification (if available)
- Time of Message
- Incoming Junction (if A Party Number is not available)

4.9 Easycall Services

Easycall Services is the generic name given to a range of customer services which are to be marketed as standard AXE facilities. The Easycall Services currently offered are Abbreviated Dialling, Call Control, Call Waiting, Third Party Enquiry/Conference, Call Diversion and Delayed Hot Line. There are additional services available in AXE which are being considered for possible future release. These include Do Not Disturb, Automatic Alarm Call, Call Forward on Busy and Call Forward on No Answer.
Easycall Services are only available from VF Touchtone telephones.

The basic features of each Easycall Service are outlined below.

Abbreviated Dialling - enables a customer to store a group of commonly called local, national or international numbers, and later dial those numbers by the use of a 1 or 2 digit code. The stored numbers can be inserted and amended in the allocated number store as required by the customer.

Call Control - gives the customer the ability to bar service to particular types of outgoing calls (ie STD, ISD, or Trunk operator) and later restore normal access from their phone.

Call Waiting - a customer engaged on a call is given a tone indication that another call is attempting to access his number. He may choose to accept or ignore the waiting call.

Third Party Enquiry/Conference - allows a customer engaged on an established call to set up an enquiry call to a third party, and allows the establishment of a Conference call with all three parties being connected.

Call Diversion - allows incoming calls to the customer's number to be redirected to another previously specified number. Currently call diversion is restricted to numbers within the same exchange.

Delayed Hot Line - service allows a customer, on lifting the handset, to be automatically connected to a pre-determined telephone number without dialling. Establishment of the Hot Line call occurs if no digits have been dialled within 4 seconds; this 4 second delay allows the customer to initiate a normal call, if desired.

TPH1019

# Integrated Digital Network– IDN Planning Letter No. 10

## Interexchange Rural Network Topology & Planning Guidelines

**August 1984**

Inquiries: K. Bell (03) 606 5268
Interexchange Networks, Transmission Planning Branch, Telecom Australia Headquarters, Melbourne
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Distribution Coding: Selective
Filing Category: P

**Telecom Australia**

RURAL NETWORK TOPOLOGY AND PLANNING GUIDELINES

FOREWORD

IDN Planning Letter No. 10 is one of a series which provides guidelines for the development of the Integrated Digital Network. The policy to develop a national IDN requires that growth throughout the network should be provided wherever economic by modern digital switching and digital transmission equipment in a co-ordinated manner.

This letter provides a strategy for the development of rural interexchange networks with modern digital transmission and switching equipment. Guidelines are given for the development of rural networks with digital transmission using the AXE Rural exchange (available 1987), the AXE remote switching stage-digital (RSS-D), the remote subscribers multiplex (RSM) and central subscribers multiplex (CSM) available 1985/86. Wherever possible, the use of the existing analogue network facilities is taken into consideration. In addition a direction is outlined for the topological development of rural interexchange networks as they progress from analogue to digital technologies with the aim of increasing network security and providing widely spread IDN facilities.

Alternative equipment configurations to RSM which could be made available in 1986/87 are currently under investigation. Further advice will be issued if these studies result in a decision to pursue this option. Additional information can be obtained from the following people in Headquarters:

Transmission Planning
K. Bell (03) 606 5268
Telephone Switching Planning
M. Slade (03) 606 5823

G. BURTON
SUPERINTENDING ENGINEER - TRANSMISSION PLANNING

3 / August 1984

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## 1. SUMMARY

IDN Planning Letter No. 10 is one of a series which provides guidelines for the development of the Integrated Digital Network. This letter provides a strategy for the development of rural interexchange networks with modern digital transmission and switching equipment so as to minimize overall network expenditure.

The planning letter is in two parts which are:

- planning guidelines for the development of rural networks with digital transmission using the AXE Rural (available 1987) the AXE remote switching stage-digital (RSS-D), the remote subscribers multiplex (RSM) and central subscribers multiplex (CSM) available 1985/86 given in Section 6.

- topological details for the development of rural interexchange networks as they progress from analogue to digital technologies are outlined in Section 7.

### 1.1 Planning Guidelines

AXE RURAL with Analogue or Digital Transmission

This system is currently being designed as a joint Telecom/Ericsson development. Progressive developments will increase the capacity of the AXE Rural and reduce its cost relative to RSS-D. With this and the superior network flexibility obtained with the AXE Rural it is expected that RSS-D will have less application in the future. AXE Planning Letter No. 5 dealing with the systems aspects of AXE Rural in some detail will be issued in the near future.

The AXE Rural will be available to develop rural networks in the latter half of 1986/87. The year be year plan is to install AXE Rural where 60 to approximately 1000 lines is required within about 5 years. The AXE Rural will work to digital or analogue transmission systems. If the transmission link is limited to only 2 Mbit/s then the AXE Rural is preferred down to 30 lines. Considering few rural terminal exchanges exceed 1000 lines, the AXE Rural will be the predominant installation. Digital multiplex equipment is required to interface the AXE Rural switch with analogue transmission systems. A Transmission Planning Branch report entitled Transmission Equipment Requirements for AXE Rural will be issued in the near future.

RSS-D with Digital Transmission

RSS-D will be available to develop rural networks after 1986/87. It is particularly suited to 1000 lines or larger. With growth the eventual development of RSS-D into an AXE 101 exchange would require individual justification. Digital transmission is required. A transmission rate of 2 Mbit/s is suitable for up to 384 lines for rural bothway calling rates of 0.06 Erlangs. A few large sized installations are envisaged.

RSM with Digital Transmission

The RSM as a connecting element of the AXE system will be available after 1985/86. For interexchange applications RSM is economic where up to 60 lines are required within about 5 years to connect customers via digital transmission to an AXE parent exchange. 2 Mbit/s transmission is required for each 30 lines. If only 2 Mbit/s transmission capacity is available the application of RSM is limited up to 30 lines. The RSM may be parented an RSS-D or SSS of the AXE 101 exchange or on the AXE Rural. RSM in the subscribers network will be addressed in IDN Planning Letter No. 14 to be published in the near future. A 2 Mbit/s G.703 interface is available with RSM.

RSM-CSM with Digital Transmission

Available after 1985/86 RSM-CSM combination for interexchange applications is economic where up to 30 lines are required within about 5 years to connect customers via digital transmission to an analogue exchange if an AXE parent exchange is not available. 2 Mbit/s transmission is required for each 30 lines. The CSM as a terminal exchange multiplexer can be converted easily to RSM if required at some later date.

ARK with Analogue or Digital Transmission

ARK exchanges will be expanded with new ARK plant until the AXE Rural is available in 1987. After this date growth at ARK locations will be taken with AXE Rural equipment. ARK purchases will be rapidly phased out after this date. With digital transmission, digital multiplex equipment will be required to interface analogue switching equipment.

RAX with Analogue or Digital Transmission

RAX exchanges with digital transmission require digital multiplex equipment, as for ARK's. In some cases two adjacent small RAX areas may be amalgamated for replacement. New ARK plant will be used for replacement prior to 1987/88. After this date AXE Rural will be used from 60 to 1000 lines. Where digital transmission is provided and an AXE 101 node is available RSM is the economic alternative up to 60 lines. With digital transmission RSM-CSM can be used with an analogue parent exchange up to 30 lines.

MANUAL with Analogue or Digital Transmission

Manual exchanges are to be phased out of the network and replacements will follow the guidelines for RAX exchanges.

## 1.2 Topology

The AXE node in country areas is now seen as closer to the secondary switching centre in the present hierarchy than to the minor switching centre. There will be a minimum number of AXE nodes established to serve a much larger number of RSS installations. Generally it will be more economic to bypass minor switching centres with additional digital transmission capacity in preference to providing transit switching capacity at the minor.

As AXE is introduced into the network existing minor switching areas will require rationalisation on economic grounds. While the existing analogue functions of the minor will remain, this should not determine the configuration of the new digital network. Careful consideration to amalgamating one MSA into the next MSA will be required for the digital network. A systematic development is envisaged where larger sized switching installations near the node will be established first.

With few terminal exchanges exceeding 1000 lines the rural network topology will consist mainly of AXE Rural with a few larger sized RSS installations and some small sized RSM, RSM-CSM applications.

Star and Ring network topologies among others are under review to meet the change in costs, demand and performance for the IDN. The results of these studies will be provided in IDN Planning Letter No. 12 Interexchange Urban Networks to be published in the near future.

## 2. INTRODUCTION

The extension of digital trunk switching and digital transmission as part of a national IDN to country urban areas will result in an IDN presence in 30% of the secondary centres and approximately 6% of the minor centres by 1985. Continued extension will proceed with a significant coverage being obtained by 1990 and most switching centres being serviced within a further five years. The remainder at this time may need to be re-assessed for their viability as a switching/transmission node.

Generally, digital facilities will be introduced into exchanges in an order determined by the customers growth rate - the faster growing exchanges having their crossbar growth curtailed first. However, as implementation progresses down the hierarchy towards the smaller, typically slower growing, minor and terminal exchanges, the economies of the AXE 101 exchange becomes less attractive, leading to the increased use of smaller scale alternatives. The alternatives are the AXE Rural available 1987, the AXE RSS-D, the remote subscribers multiplex (RSM) and central subscribers multiplex (CSM) which will be available 1985/86. These modern digital equipments will be used to develop rural networks which consist of a large number of small size exchanges. These existing exchanges typically range from 30 to 600 lines of ARK, RAX and manual exchanges and are interconnected by analogue transmission systems. Manual exchanges are being phased out of the network.

The development of the IDN depends on having available adequate digital transmission facilities. The purchase of analogue radio transmission systems will be phased out from June 1984 with the aim of ceasing purchases by 1986/87, reference IDN Planning Letter No. 5. Generally, FDM equipment purchases will be phased out from 1985. Overall analogue transmission equipment purchases will decline from 1984 onwards and virtually cease by 1988, reference IDN Planning Letter No. 9B. Where transmission links require upgrading to meet growth or provide new facilities the new links will be digital. For existing analogue transmission systems channel modems recovered from upgraded systems will be used for growth until the system capacity requires the installation of digital transmission. Open wire routes are to be replaced with optic fibre or digital radio systems. Similarly pair cable and SQC cable systems depending upon the capacity required are to be upgraded to digital or replaced with optic fibre or digital radio system.

A basic thrust of the IDN strategy is to make available enhanced facilities throughout the network. In providing these facilities the aim is to minimise overall network expenditure. Planning guidelines given in Section 6 indicate a preference for the application of these modern equipments which minimise overall network expenditure. The traditional star network topology has in the past been able to satisfy demand and performance criteria for telephony at reasonable cost. However with the IDN, costs, demand and performance will change. A topological direction for the development of the IDN is outlined in Section 7.

## 3. DIGITAL SWITCHING SYSTEMS

The application of digital switching systems namely the AXE 101 exchange, the AXE Rural and RSS-D is shown in figures 1 and 2. In some situations the AXE 101 exchange may be economic for more than 2000 lines depending on the infrastructure at the location concerned and the regional network to be served. The RSS-D can be provided in 2048 line modules with a minimum size of 128 lines and is intended for medium range applications. Large installations of RSS up to 6K or even 8K lines may be justified so as to reduce the number of AXE 101 nodes. The AXE Rural is designed for smaller sized applications and is available from 30 to 2000 lines.

The RSS-D requires digital transmission whereas the AXE Rural will work to both digital and analogue transmission. Further information is given in Appendix B.

## 4. RSM AND CSM

The application of RSM as a connecting element of the AXE system in the interexchange network is shown in figures 1 and 2. The RSM is designed for small applications in 30 line modules. The application of CSM as a terminal exchange multiplexer is shown in figure 1. The RSM can work to CSM via digital transmission and connect subscribers to an analogue parent exchange. 2 Mbit/s transmission is required for every 30 lines. Further details are given in Appendix C. These equipments also have applications in the subscribers network and will be addressed in IDN Planning Letter No. 14 to be published in the near future.

## 5. DIGITAL TRANSMISSION SYSTEMS

IDN Planning Letters No's 4, 5 and 9B, references 6, 7 and 8 provide planning guidelines for transmission systems in rural areas. When considering the transmission role as part of a network study common costs can be removed. Therefore the transmission costs used for economic evaluation studies exclude the common bearer cost. The required transmission capacity varies for different AXE equipments. For example a 60 line RSM requires 2 x 2 Mbit/s however a 64 line RSS-D requires only 2 Mbit/s.

A 2 Mbit/s transmission system is required for each RSM 30 module. This transmission capacity is also sufficient for up to 384 lines of RSS-D or AXE Rural for typical rural traffic with a both way calling rate equal to 0.06 Erlangs per service.

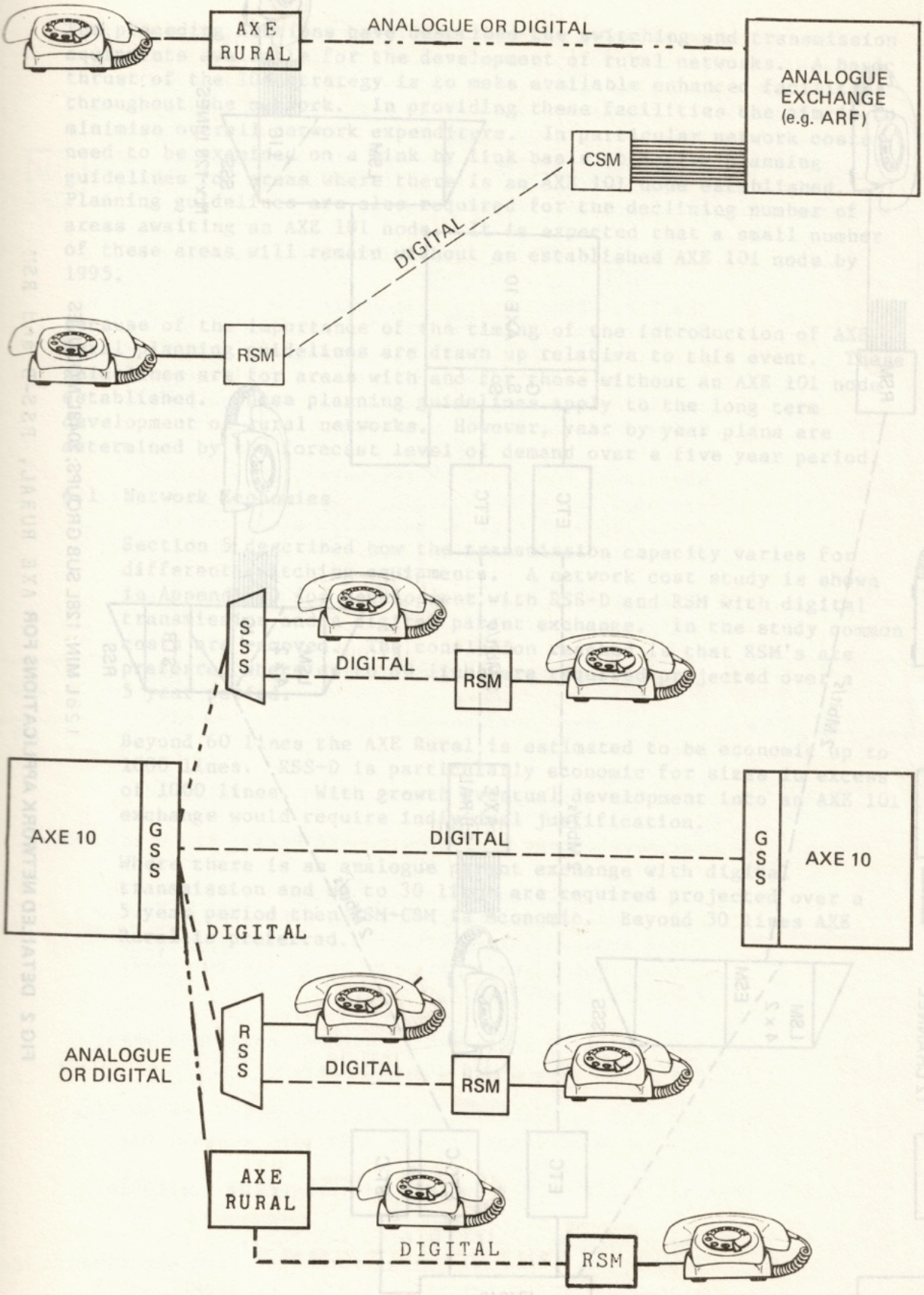



FIG1 EQUIPMENT APPLICATIONS

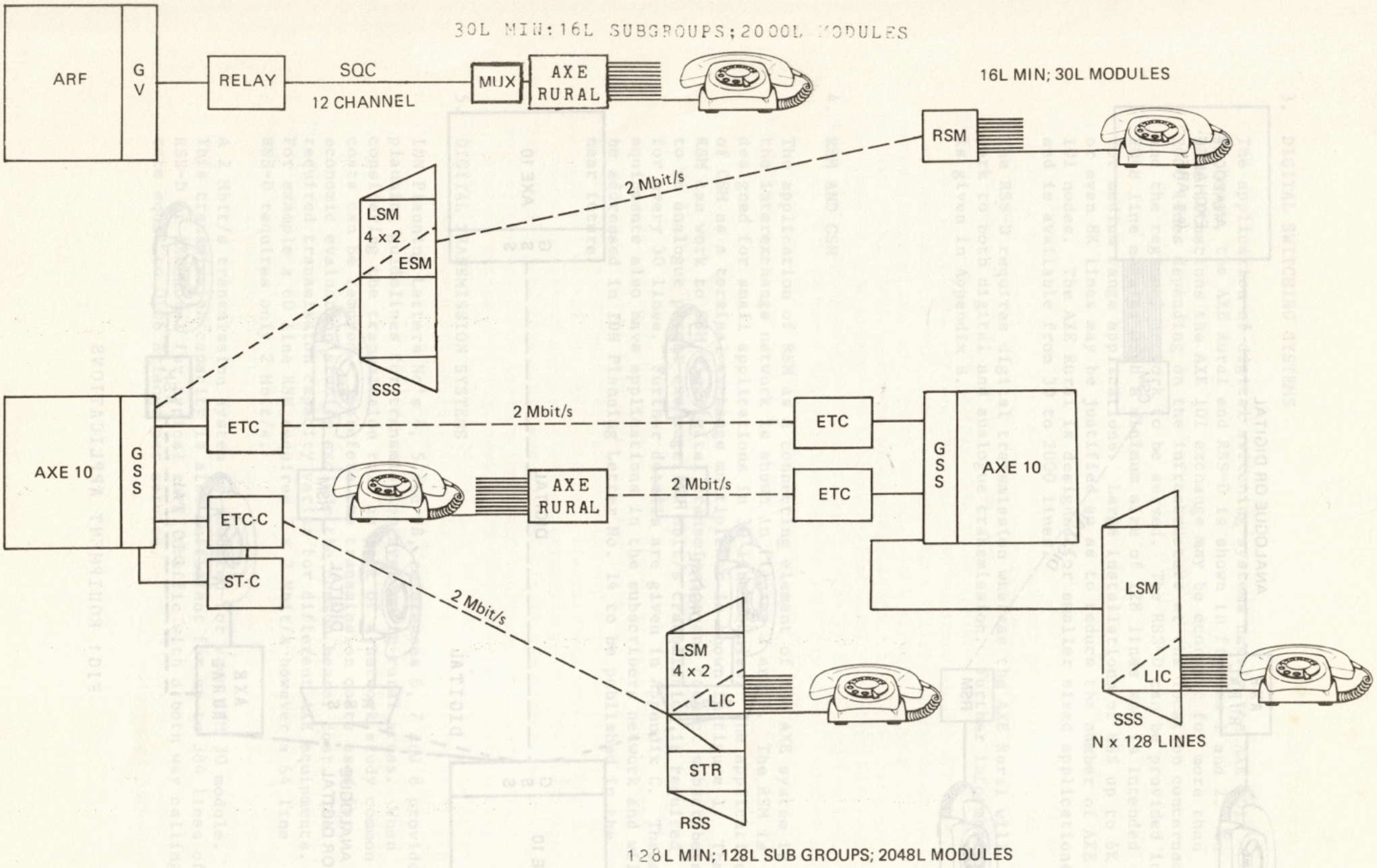



**FIG 2 DETAILED NETWORK APPLICATIONS FOR AXE RURAL, RSS-D and RSM**

## 6. PLANNING GUIDELINES

The preceding Sections have described the switching and transmission equipments available for the development of rural networks. A basic thrust of the IDN strategy is to make available enhanced facilities throughout the network. In providing these facilities the aim is to minimise overall network expenditure. In particular network costs need to be examined on a link by link basis to derive planning guidelines for areas where there is an AXE 101 node established. Planning guidelines are also required for the declining number of areas awaiting an AXE 101 node. It is expected that a small number of these areas will remain without an established AXE 101 node by 1995.

Because of the importance of the timing of the introduction of AXE Rural planning guidelines are drawn up relative to this event. These guidelines are for areas with and for those without an AXE 101 node established. These planning guidelines apply to the long term development of rural networks. However, year by year plans are determined by the forecast level of demand over a five year period.

### 6.1 Network Economies

Section 5 described how the transmission capacity varies for different switching equipments. A network cost study is shown in Appendix D for development with RSS-D and RSM with digital transmission and a digital parent exchange. In the study common costs are removed. The conclusion reached is that RSM's are preferred where up to 60 lines are required projected over a 5 year period.

Beyond 60 lines the AXE Rural is estimated to be economic up to 1000 lines. RSS-D is particularly economic for sizes in excess of 1000 lines. With growth eventual development into an AXE 101 exchange would require individual justification.

Where there is an analogue parent exchange with digital transmission and up to 30 lines are required projected over a 5 year period then RSM-CSM is economic. Beyond 30 lines AXE Rural is preferred.

## 6.2 AXE Minor Switching Area

The following planning guidelines are set out pre and post AXE Rural cutover 1987 for areas selected for AXE installation at the Minor Switching Centre. An example of the following guidelines for AXE areas is shown in figure 3. Slower growing minor switching centres may have their growth catered for by the installation of AXE Rural which may perform both terminal and transit switching functions. The guidelines are for year by year plans projected over a five year period.

### 6.2.1 Pre AXE Rural - Digital Transmission is Available

- The first RSS-D installations in the country will be 86/7 and the AXE Rural will be available in the latter half of 1986/87. In situations where AXE Rural is preferred but not yet available growth should be taken using incremental ARK equipment. Below 60 lines RSM is preferred.

- Where some RAX plant is recovered, or a manual exchange is to be replaced, new ARK equipment will be installed with digital multiplex equipment to interface the transmission system beyond 60 lines.

- Existing ARK plant will be expanded with new ARK equipment until 1987/8.

### 6.2.2 Pre AXE Rural - Analogue Transmission is Available

All exchange development will be met with new ARK equipment until 1987/8.

### 6.2.3 Post AXE Rural - Digital Transmission is Available

- The development will be with AXE Rural, RSS-D and RSM.

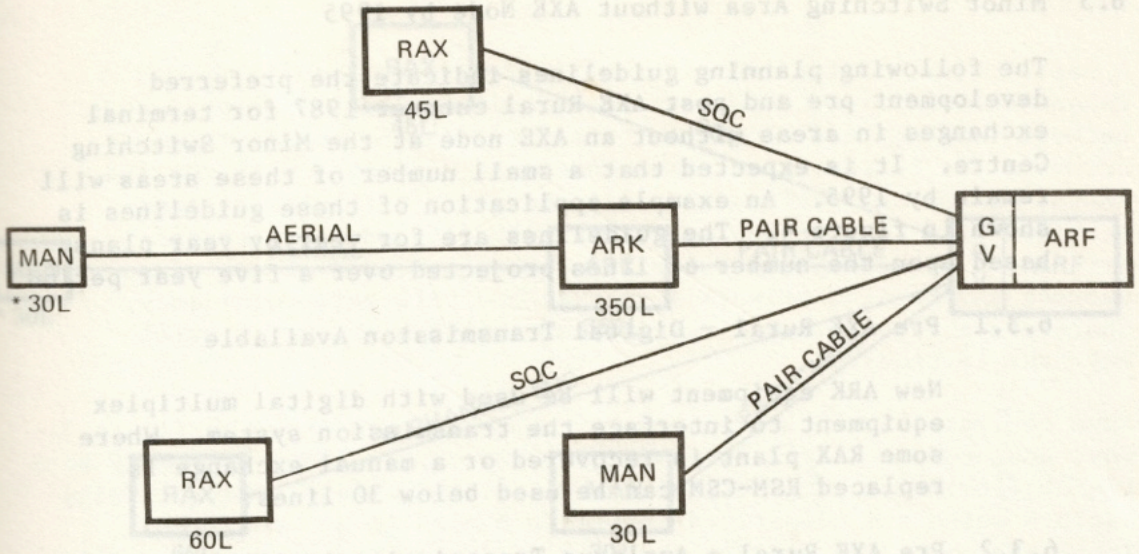
- AXE Rural will be installed to replace or provide additional capacity at existing analogue exchanges in rural areas. The application is between 60 to 1000 lines. The lower limit will be 30 lines if only 2 Mbit/s is available.

- RSS-D will be installed to augment exchanges when more than 1000 lines are required.

- RSM will be installed for requirements up to 60 lines and up to 30 lines if only 2 Mbit/s is available.

### 6.2.4 Post AXE Rural - Only Analogue Transmission Available

- The development will be with AXE Rural up to 2000 lines. Channel modems recovered from upgraded transmission systems will be used for growth until the system capacity requires the installation of digital transmission.

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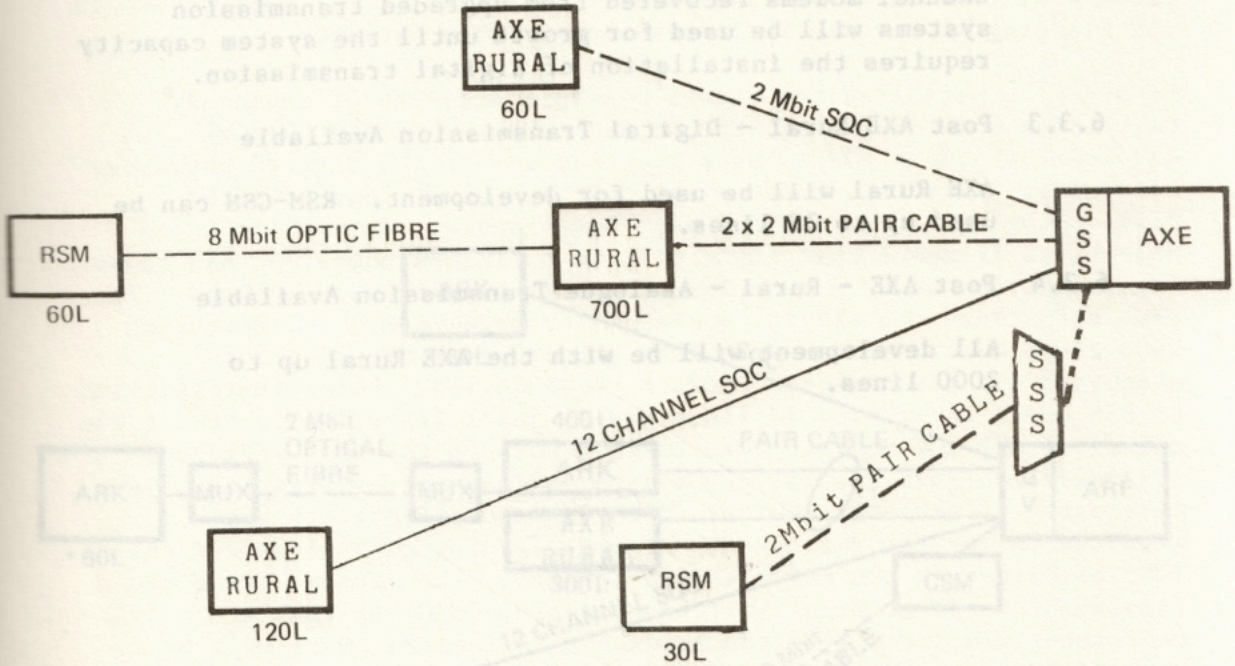



1995

*ARF PARENT

FIG. 3 EXAMPLE FOR MSA WITH AXE INSTALLED

## 6.3 Minor Switching Area without AXE Node by 1995

The following planning guidelines indicate the preferred development pre and post AXE Rural cutover 1987 for terminal exchanges in areas without an AXE node at the Minor Switching Centre. It is expected that a small number of these areas will remain by 1995. An example application of these guidelines is shown in figure 4. The guidelines are for year by year plans based upon the number of lines projected over a five year period.

### 6.3.1 Pre AXE Rural - Digital Transmission Available

New ARK equipment will be used with digital multiplex equipment to interface the transmission system. Where some RAX plant is recovered or a manual exchange is replaced RSM-CSM can be used below 30 lines.

### 6.3.2 Pre AXE Rural - Analogue Transmission Available

All development will be with new ARK equipment.

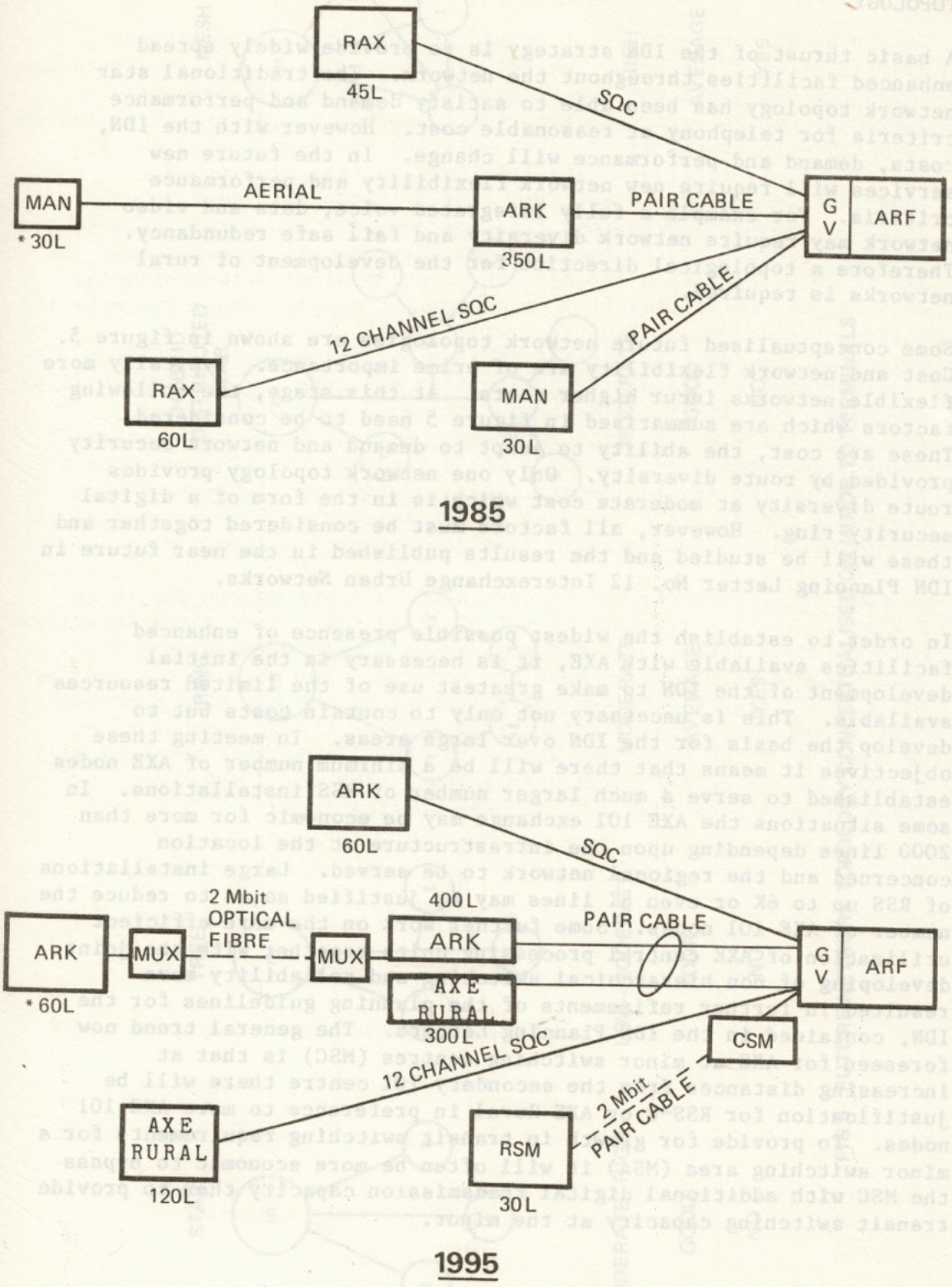
Channel modems recovered from upgraded transmission systems will be used for growth until the system capacity requires the installation of digital transmission.

### 6.3.3 Post AXE Rural - Digital Transmission Available

AXE Rural will be used for development. RSM-CSM can be used up to 30 lines.

### 6.3.4 Post AXE - Rural - Analogue Transmission Available

All development will be with the AXE Rural up to 2000 lines.




*ARF PARENT

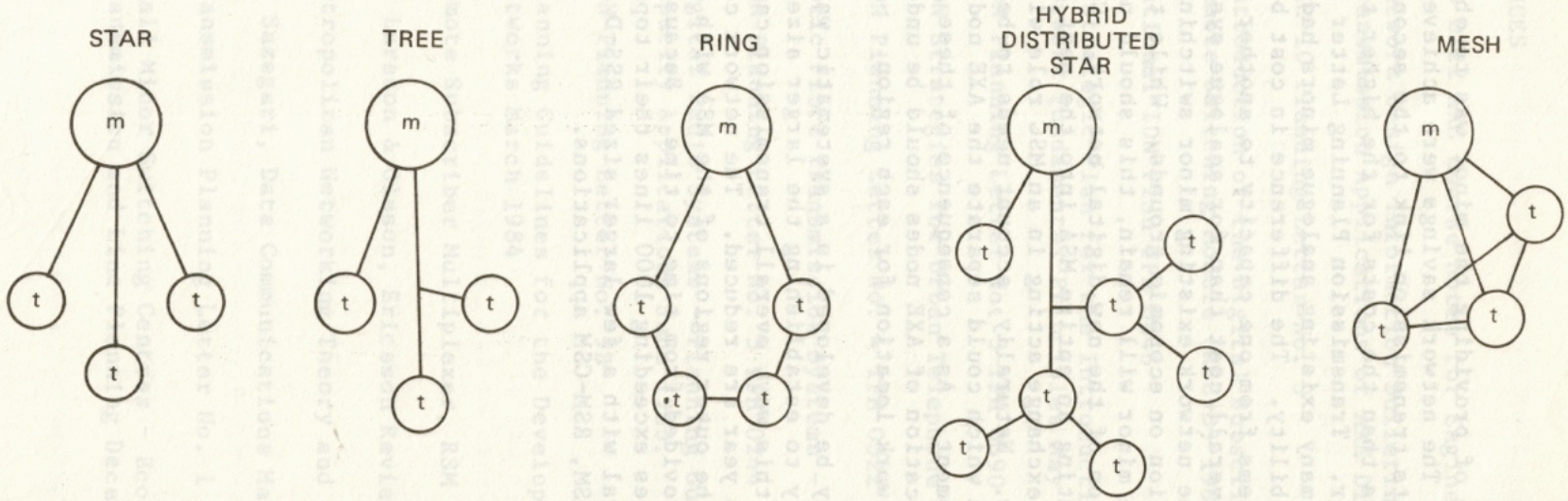
FIG 4 EXAMPLE FOR MSA WITHOUT AXE INSTALLED BY 1995

## 7. TOPOLOGY

A basic thrust of the IDN strategy is to provide widely spread enhanced facilities throughout the network. The traditional star network topology has been able to satisfy demand and performance criteria for telephony at reasonable cost. However with the IDN, costs, demand and performance will change. In the future new services will require new network flexibility and performance criteria. For example a fully integrated voice, data and video network may require network diversity and fail safe redundancy. Therefore a topological direction for the development of rural networks is required.

Some conceptualised future network topologies are shown in figure 5. Cost and network flexibility are of prime importance. Typically more flexible networks incur higher costs. At this stage, the following factors which are summarised in figure 5 need to be considered. These are cost, the ability to adapt to demand and network security provided by route diversity. Only one network topology provides route diversity at moderate cost which is in the form of a digital security ring. However, all factors must be considered together and these will be studied and the results published in the near future in IDN Planning Letter No. 12 Interexchange Urban Networks.

In order to establish the widest possible presence of enhanced facilities available with AXE, it is necessary in the initial development of the IDN to make greatest use of the limited resources available. This is necessary not only to contain costs but to develop the basis for the IDN over large areas. In meeting these objectives it means that there will be a minimum number of AXE nodes established to serve a much larger number of RSS installations. In some situations the AXE 101 exchange may be economic for more than 2000 lines depending upon the infrastructure at the location concerned and the regional network to be served. Large installations of RSS up to 6K or even 8K lines may be justified so as to reduce the number of AXE 101 nodes. Some further work on the more efficient utilisation of AXE central processing units together with the joint developing of non hierarchical switching and reliability have resulted in further refinements of the planning guidelines for the IDN, contained in the IDN Planning Letters. The general trend now foreseen for AXE at minor switching centres (MSC) is that at increasing distances from the secondary 101 centre there will be justification for RSS-D or AXE Rural in preference to more AXE 101 nodes. To provide for growth in transit switching requirements for a minor switching area (MSA) it will often be more economic to bypass the MSC with additional digital transmission capacity than to provide transit switching capacity at the minor.




| | STAR | TREE | RING | HYBRID DISTRIBUTED STAR | MESH |
|---|---|---|---|---|---|
| AMOUNT OF FIBRE CABLE USED | MODERATE–HIGH | LOW–MODERATE | MODERATE | MODERATE | HIGH |
| ABILITY TO ADAPT TO DEMAND | GOOD | POOR | AVERAGE | GOOD | AVERAGE |
| PROVIDES ROUTE DIVERSITY | NO | NO | YES | NO | YES |

FIG 5 FUTURE NETWORK TOPOLOGY CONCEPTUALISED ON MINOR TO TERMINALS

Within an MSA the purpose of providing the minor was to obtain overall network savings. The network savings were achieved where the costs for the minor and its transmission link to the secondary switching centre were less than the costs for the higher transmission capacity without the minor. Transmission Planning Letter No. 1 (Reference 11) concluded many existing analogue minors had questionable economic viability. The difference in cost between digital transmission systems from one capacity to another will be a smaller fraction of the overall cost than for analogue systems. As AXE is introduced into the network existing minor switching areas will require rationalisation on economic grounds. While the existing analogue functions at the minor will remain, this should not determine the configuration of the new digital network. Careful consideration to amalgamating an entire MSA into the next MSA will be required. The AXE Rural exchange acting in an MSC role will influence these economics. Naturally, account needs to be taken of changes in network growth which could separate the AXE node from the location of the ARM equipment. As a consequence of these changes, a review of the proposed location of AXE nodes should be undertaken to determine the optimum network location for each region.

So that rural networks may be developed in a systematic way it is preferred to give priority to establishing the larger sized locations near the node first. In this way, overall transmission capacity requirements from year to year are reduced. The network can then be built upon to spread to the outer regions of the MSA with appropriate digital security rings provided from time to time. Because rural networks have few exchanges exceeding 1000 lines their topology will consist mainly of AXE Rural with a few larger sized RSS-D installations plus some RSM, RSM-CSM applications.

## 8. REFERENCES


1. ED 0122 AXE Course Notes for Engineers 1982.

2. Network Design Information Bulletin No. 2 TPH 0471 Network Transmission Applications of AXE Digital Exchanges April 1983.

3. AXE 10 Planning Letter No. 3

   Introduction of the Digital Subscriber Switching Stage as a Remote Switching Module (RSS-D) 1982.

4. National IDN Plan TPH 0646

   A Strategic Plan for the Introduction of the Integrated Digital Network Fundamental Principles May 1983.

5. IDN Planning Letter No. 3 TPH 0690

   IDN Strategies for Urban Telephone Networks July 1983.

6. IDN Planning Letter No. 4 TPH 0022

   Optic Fibre Transmission Systems - Planning Guidelines May 1983.

7. IDN Planning Letter No. 5 TPH 0244

   Digital Radio Systems - Planning Guidelines Low and Medium Capacity Applications June 1983.

8. IDN Planning Letter No. 9B

   Planning Guidelines for the Development of Rural Transmission Networks March 1984

9. Remote Subscriber Multiplexer, RSM

   by Larsson & Olsson, Ericsson Review No. 2 1983 pp 59-65.

10. Metropolitan Networking Theory and Practice

    by Sazegari, Data Communications March 1983.

11. Transmission Planning Letter No. 1

    Small Minor Switching Centres - Economic Considerations by Transmission and Line Planning December 1974.

## APPENDIX A LIST OF ABBREVIATIONS

| | |
|---|---|
| IDN | Integrated Digital Network |
| RSS-D | Remote Switching Stage - Digital |
| ETC-C | Exchange Terminal Circuit for Common Channel Signalling |
| ST-C | Signal Terminal - Central |
| ST-R | Signal Terminal - Regional |
| GSS | Group Switching Stage |
| SSS | Subscriber Switching Stage |
| LSM | Line Switch Module |
| LIC | Line Interface Circuit |
| MSA | Minor Switching Area |
| MSC | Minor Switching Centre |
| RSM | Remote Subscribers Multiplex |
| CSM | Central Subscribers Multiplex |
| ESM | Exchange Subscribers Multiplex |

## APPENDIX B DIGITAL SWITCHING EQUIPMENTS

Digital switching equipments for rural applications include the AXE 101 exchange, the AXE Rural exchange and the remote switching stage - digital (RSS-D). These equipments are shown in figure 1. Further information on AXE exchanges is given in references (1) and (2), on RSS-D in reference (3).

RSS-D can be equipped in modules of 2048 lines or partially equipped in sub groups of 128 lines with a minimum installation of 128 lines. For rural applications with a both way calling rate of 0.06 Erlangs a 2 Mbit/s transmission system is adequate for up to 384 lines. The application of a minimum 2 Mbit/s transmission system to provide links to a 384 line RSS-D supersedes section 8.2 of reference (3).

The AXE Rural exchange available in the latter half of 1986/87 will provide enhanced facilities with digital transmission. It will work over analogue transmission with the addition of digital multiplex equipment. The AXE Rural can be supplied in sub modules of 60 lines up to 2000 line modules. Present costs indicate a preference for RSS-D larger than 1000 lines where there is high growth rate. The AXE Rural can be used for growth or replacement of existing rural analogue exchanges. The application of AXE Rural is shown in figure 2.

The following features will be available.

- Information signalling using MFC signalling.
- Capable of connecting to analogue transmission paths using either physical circuits (using L type line signalling) or FDM carrier (using T type line signalling) circuits.
- Compatible with the IDN; that is the exchange must be transparent to 64 kbit/s digital signals, and be capable of direct connection to 2 Mbit/s systems.
- Capable of enhancement with common channel signalling system No. 7.
- Capacity for some direct routing.
- Facilities for remote operations and maintenance, including limited diagnosis of fault conditions, and ability to remotely connect and disconnect.
- Ability to support modern customer facilities such as Call Waiting, or Speed Calling.
- Complete independence from other exchanges with respect to all call handling functions.

## APPENDIX C RSM & CSM EQUIPMENTS

The application of RSM as a connecting element of the AXE system is shown in figures 1 and 2. Where as the RSS-D is connected to the group switching stage (GSS) direct, RSM is connected to GSS via either subscribers switching stage (SSS) at the parent exchange or at a remote location via RSS-D which can have a minimum installation of 128 lines. RSM can also be parented on to the subscriber stage of the AXE Rural exchange. Although RSM can be used in 30 line modules it can be incremented by 16 line sub modules with a minimum installation of 16 lines. Each 30 line module requires a 2 Mbit/s transmission system. A 2 Mbit/s G.703 interface is available with RSM.

To connect RSM to a SSS or RSS-D the line interface circuits (LIC) are replaced by an exchange subscriber multiplexer (ESM). The equipment cost of the line switch module (LSM) with LIC is approximately twice that of the LSM with ESM of equivalent size as shown in figure 2. As each LSM contains 128 subscriber line interface circuits as ESM it is possible to connect up to four 2 Mbit/s line systems.

The application of the CSM as a terminal exchange multiplexer is shown in figure 1. CSM can be used at an analogue exchange to connect customers via a digital transmission system from a remote location with RSM. If desired at some future date the CSM can be converted to RSM by changing a few cards.

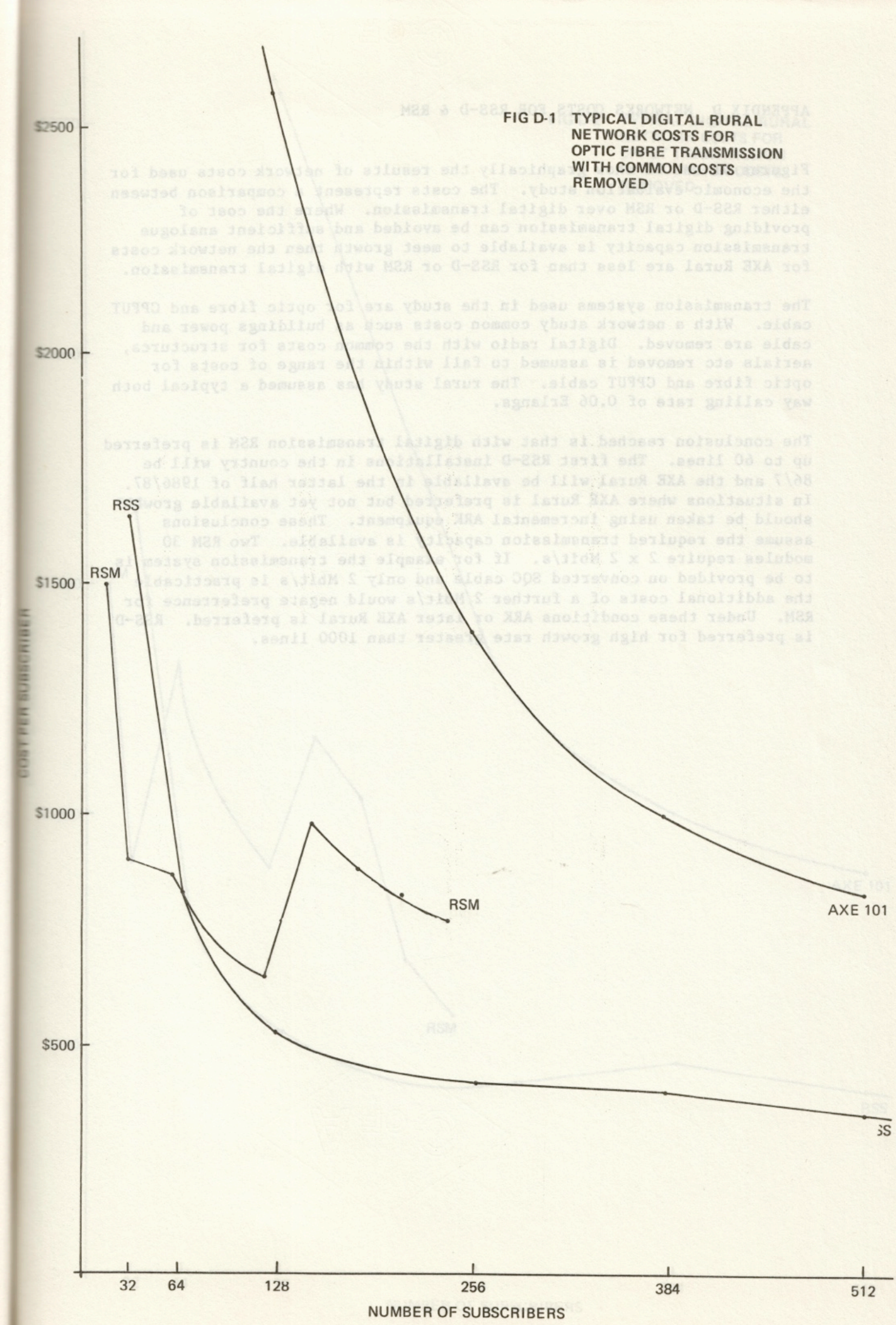



FIG D-1 TYPICAL DIGITAL RURAL NETWORK COSTS FOR OPTIC FIBRE TRANSMISSION WITH COMMON COSTS REMOVED

## APPENDIX D NETWORKS COSTS FOR RSS-D & RSM

Figures D1 and D2 show graphically the results of network costs used for the economic evaluation study. The costs represent a comparison between either RSS-D or RSM over digital transmission. Where the cost of providing digital transmission can be avoided and sufficient analogue transmission capacity is available to meet growth then the network costs for AXE Rural are less than for RSS-D or RSM with digital transmission.

The transmission systems used in the study are for optic fibre and CPFUT cable. With a network study common costs such as buildings power and cable are removed. Digital radio with the common costs for structures, aerials etc removed is assumed to fall within the range of costs for optic fibre and CPFUT cable. The rural study has assumed a typical both way calling rate of 0.06 Erlangs.

The conclusion reached is that with digital transmission RSM is preferred up to 60 lines. The first RSS-D installations in the country will be 86/7 and the AXE Rural will be available in the latter half of 1986/87. In situations where AXE Rural is preferred but not yet available growth should be taken using incremental ARK equipment. These conclusions assume the required transmission capacity is available. Two RSM 30 modules require 2 x 2 Mbit/s. If for example the transmission system is to be provided on converted SQC cable and only 2 Mbit/s is practicable the additional costs of a further 2 Mbit/s would negate preferrence for RSM. Under these conditions ARK or later AXE Rural is preferred. RSS-D is preferred for high growth rate greater than 1000 lines.

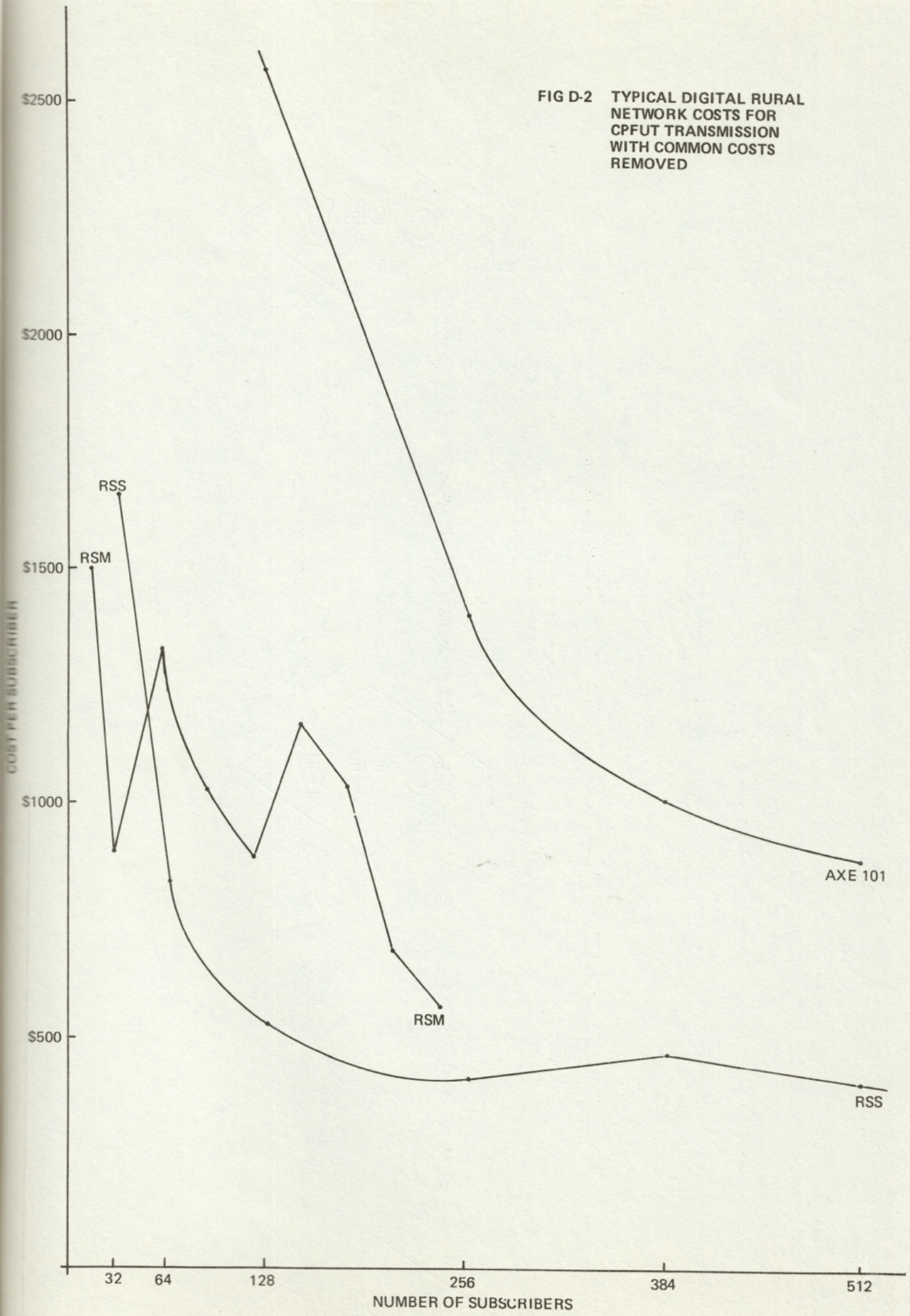
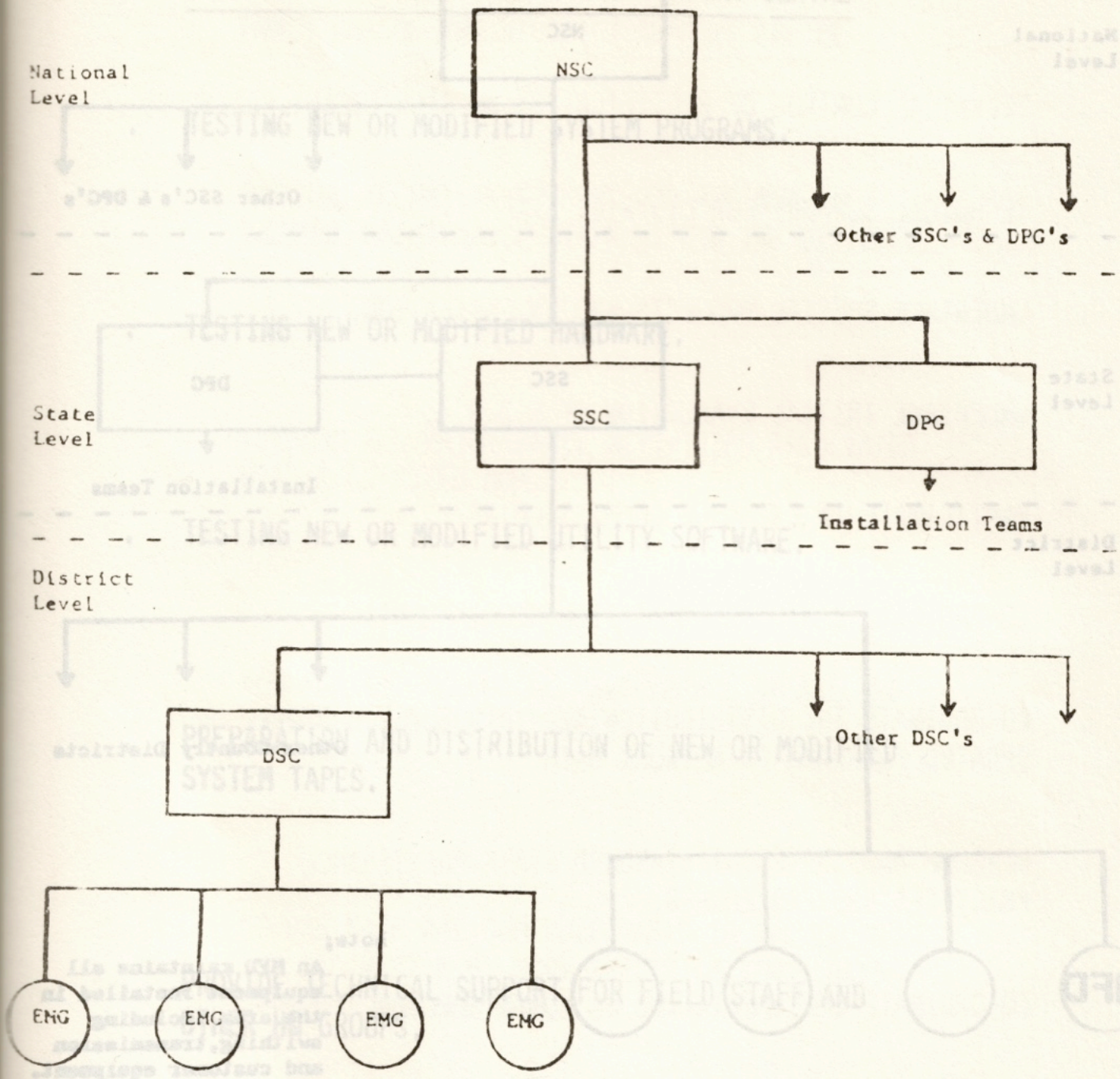



FIG D-2 TYPICAL DIGITAL RURAL NETWORK COSTS FOR CPFUT TRANSMISSION WITH COMMON COSTS REMOVED

PART 2

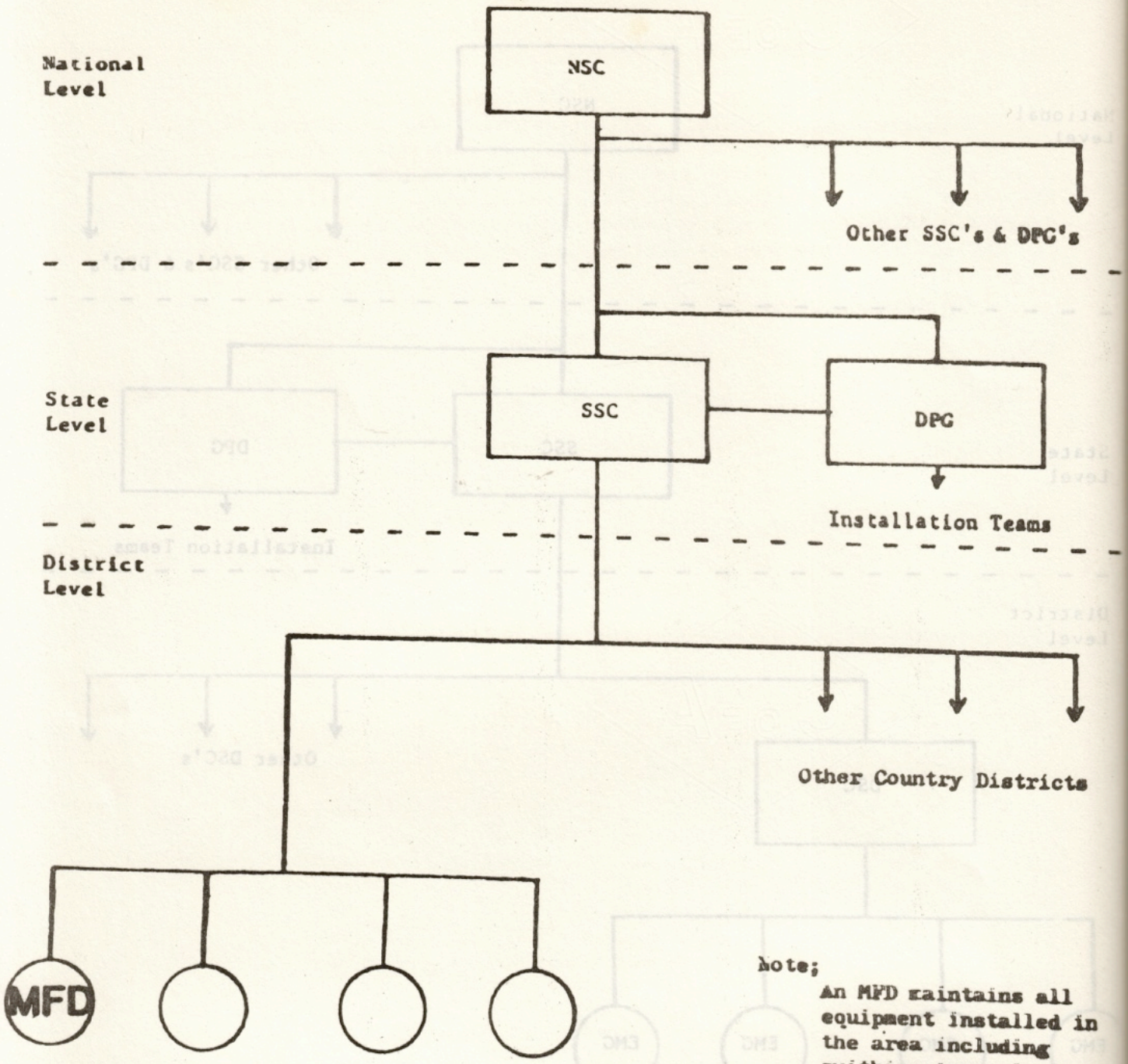
COPIES OF OVERHEAD TRANSPARENCIES

The following pages contain illustrations from a presentation to Operations districts on the introduction of AXE into metropolitan and country exchanges. These presentations have been sponsored by the MEMO/CEMO Steering Committee with additional contributions from Operations districts, Human Resources Department, Construction Branch and the ARE/AXE/AOM State Support Centre.




Legend: NSC - National Support Centre
SSC - State Support Centre
DSC - District Support Centre
EMG - Exchange Maintenance Group
DPG - Data Production Group

## Metropolitan Exchange Maintenance Organisation (MEMO)




Country Multi Functional Technician Districts (MFD)

## PROPOSED AXE MAINTENANCE ARRANGEMENTS FOR RURAL AREAS

## FUNCTIONS OF AXE/AOM NATIONAL SUPPORT CENTRE

- TESTING NEW OR MODIFIED SYSTEM PROGRAMS.

- TESTING NEW OR MODIFIED HARDWARE.

- TESTING NEW OR MODIFIED UTILITY SOFTWARE.

- PREPARATION AND DISTRIBUTION OF NEW OR MODIFIED SYSTEM TAPES.

- PROVIDE TECHNICAL SUPPORT FOR FIELD STAFF AND OTHER HQ GROUPS.

## FUNCTIONS OF THE ARE/AXE STATE SUPPORT CENTRE

- TECHNICAL CONTROL OF RECTIFICATION OF SIGNIFICANT FAILURES.
- TECHNICAL SUPPORT FOR DISTRICT STAFF.
- UNDERTAKE SPECIAL PROJECTS AND INVESTIGATION.
- UNDERTAKE INITIAL EVALUATION OF S.D.R.s.
- PARTICIPATE IN EXCHANGE COMMISSIONING.
- CO-ORDINATE STATE DOCUMENTATION REQUIREMENTS.
- CO-ORDINATE THE DISTRIBUTION AND INTRODUCTION OF NEW OR UPDATED PROGRAMS OR NETWORK DATA.
- DEVELOP AND IMPLEMENT STANDARD STATE MAINTENANCE PRACTICES AND PROCEDURES.
- CO-ORDINATE IMPLEMENTATION OF WORKS SPECIFICATIONS.
- OVERSIGHT THE OPERATION OF THE CENTRAL PARTS STORE.
- AOM CO-ORDINATION.

REFERENCE: TPH 0463

## FUNCTIONS OF THE DISTRICT SUPPORT CENTRE

- PROVIDE TECHNICAL SUPPORT FOR ARE AND AXE EXHANGE MAINTENANCE STAFF WITHIN THE DISTRICT.

- PERFORM ALL MAINTENANCE ACTIVITIES ASSOCIATED WITH A CO-SITED AOM.

- ANALYSE THE TECHNICAL PERFORMANCE OF ALL SPC EXCHANGES IN THE DISTRICT.

- CO-ORDINATE AND SCHEDULE TASKS IN SPC EXCHANGES FOR DISTRICT E.G. WORK SPECIFICATIONS, DATA CHANGES, NEW SOFTWARE, ETC.

REFERENCE: TPH 0464

## FUNCTIONS OF THE EXCHANGE MAINTENANCE GROUP

. PERFORM ALL MAINTENANCE ACTIVITIES ASSOCIATED WITH ELECTROMECHANICAL EXCHANGES.

. PERFORM FIRST-IN FAULT DIAGNOSIS AND REPAIR FOR ARE AND AXE EXCHANGES.

. PERFORM ALL CUSTOMER FACILITY CHANGES FOR ARE AND AXE EXCHANGES.

. PERFORM ALL MDF, POWER AND BUILDING ACTIVITIES.

REFERENCE: TPH 0497

## FUNCTIONS OF THE MULTIFUNCTIONAL DISTRICT (MFD)

- PERFORM ALL MAINTENANCE ACTIVITIES ASSOCIATED WITH ELECTROMECHANICAL EXCHANGES.

- PERFORM FIRST-IN FAULT DIAGNOSIS AND REPAIR FOR AXE EXCHANGES.

- PERFORM ALL CUSTOMER FACILITY CHANGES FOR ELECTROMECHANICAL AND AXE EXCHANGES.

- PERFORM ALL MDF, POWER AND BUILDING ACTIVITIES.

## FUNCTIONS OF THE DATA PRODUCTION GROUP

- PREPARE DATA FOR STATE ARE 'ND AXE CONSTRUCTION PROJECTS.

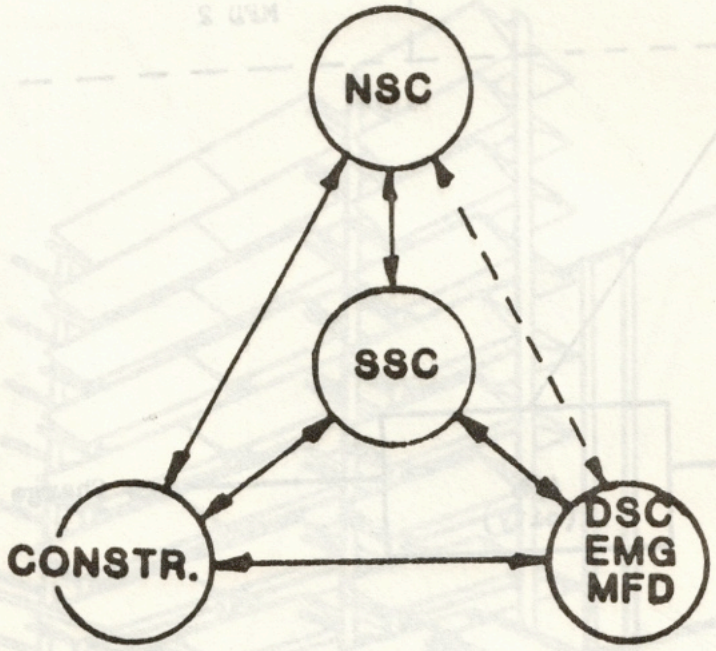
- RUN SUPPORT UTILITIES AND GENERATE DATA TAPES.

- PREPARE AND MAINTAIN ARE AND AXE TEST DATA.

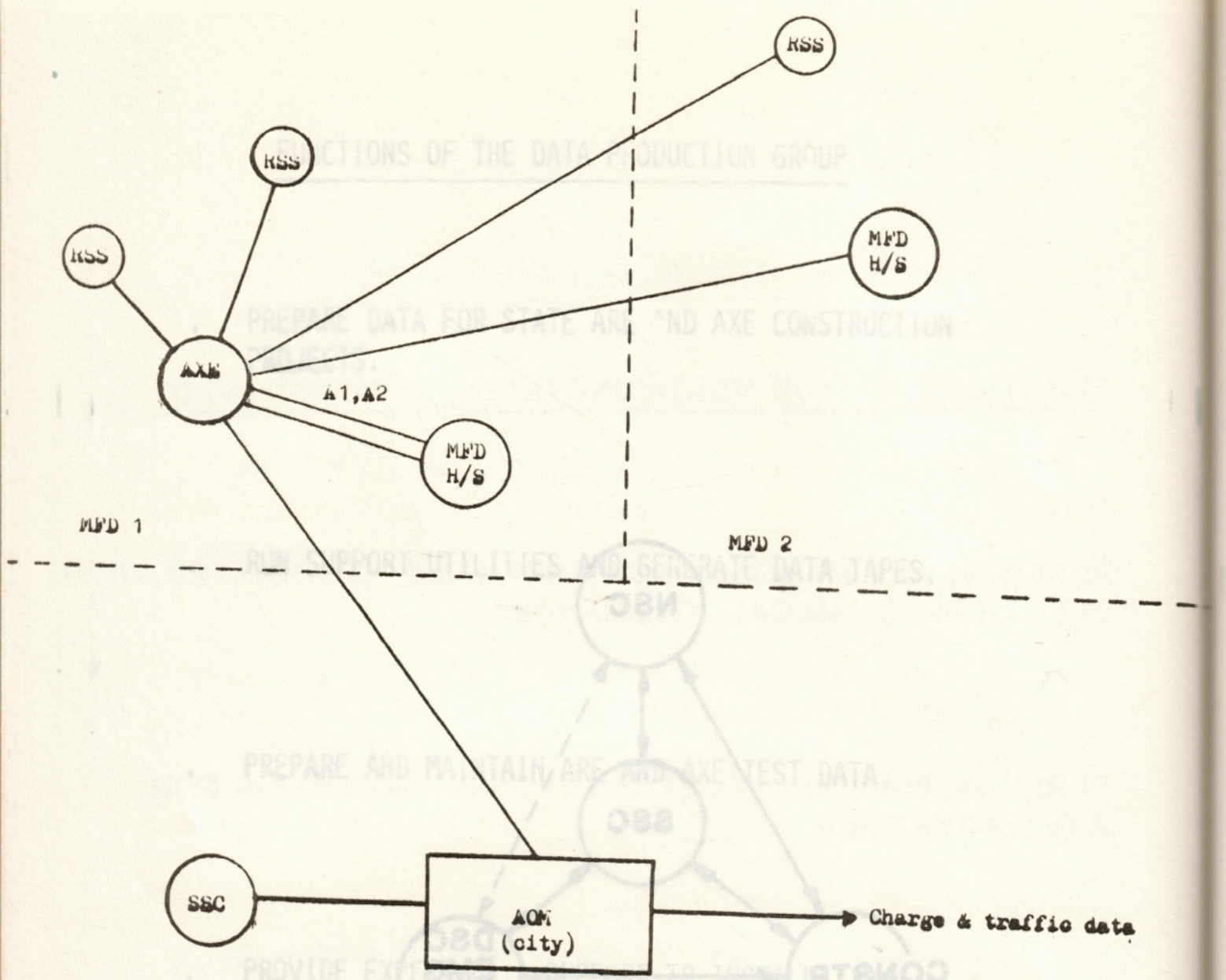
- PROVIDE EXPERT DATA SUPPORT TO INSTALLATION FIELD STAFF.

- ARE TRS AND SCS RE-ASSEMBLIES UNDER CONTRACT TO SSC.

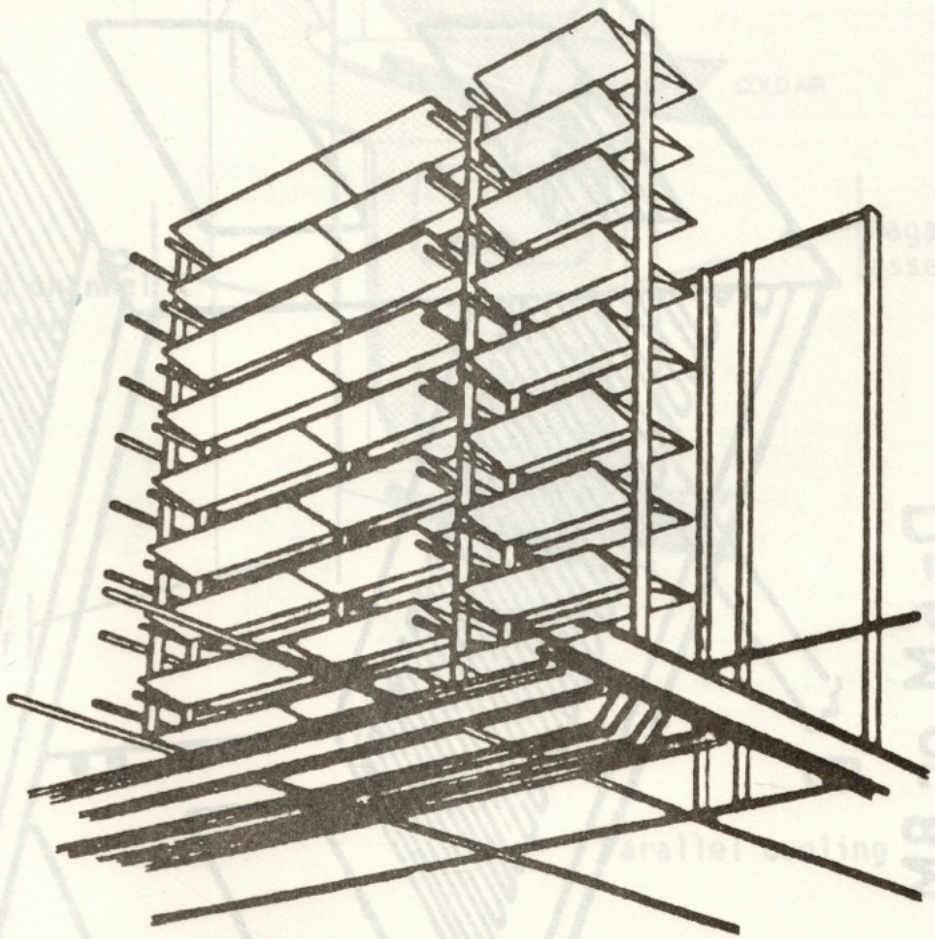
REFERENCE: TSC/1E/036




**INTERWORKING RELATIONSHIPS**




PROPOSED AXE MAINTENANCE ARRANGEMENTS FOR RURAL AREAS



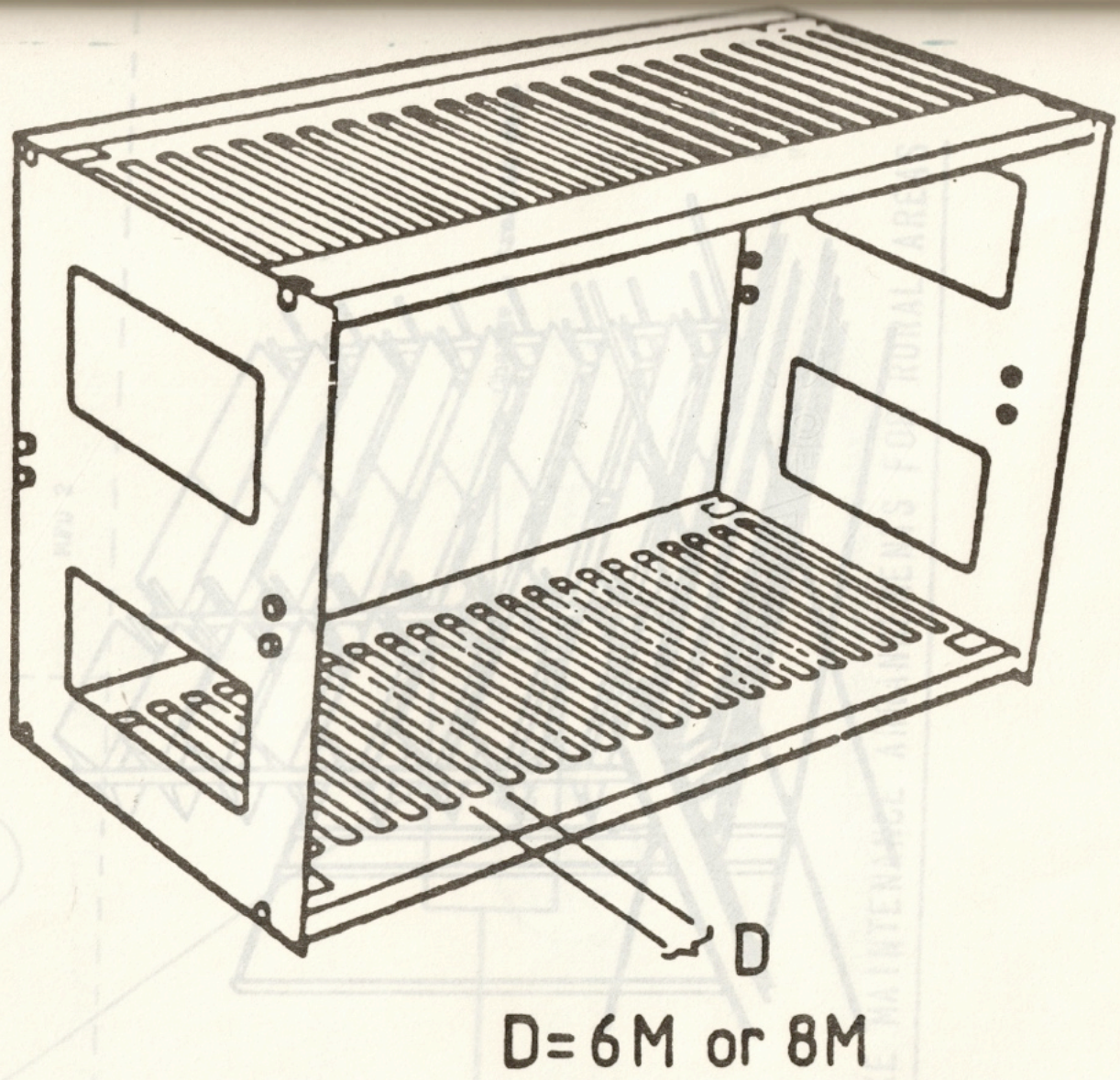
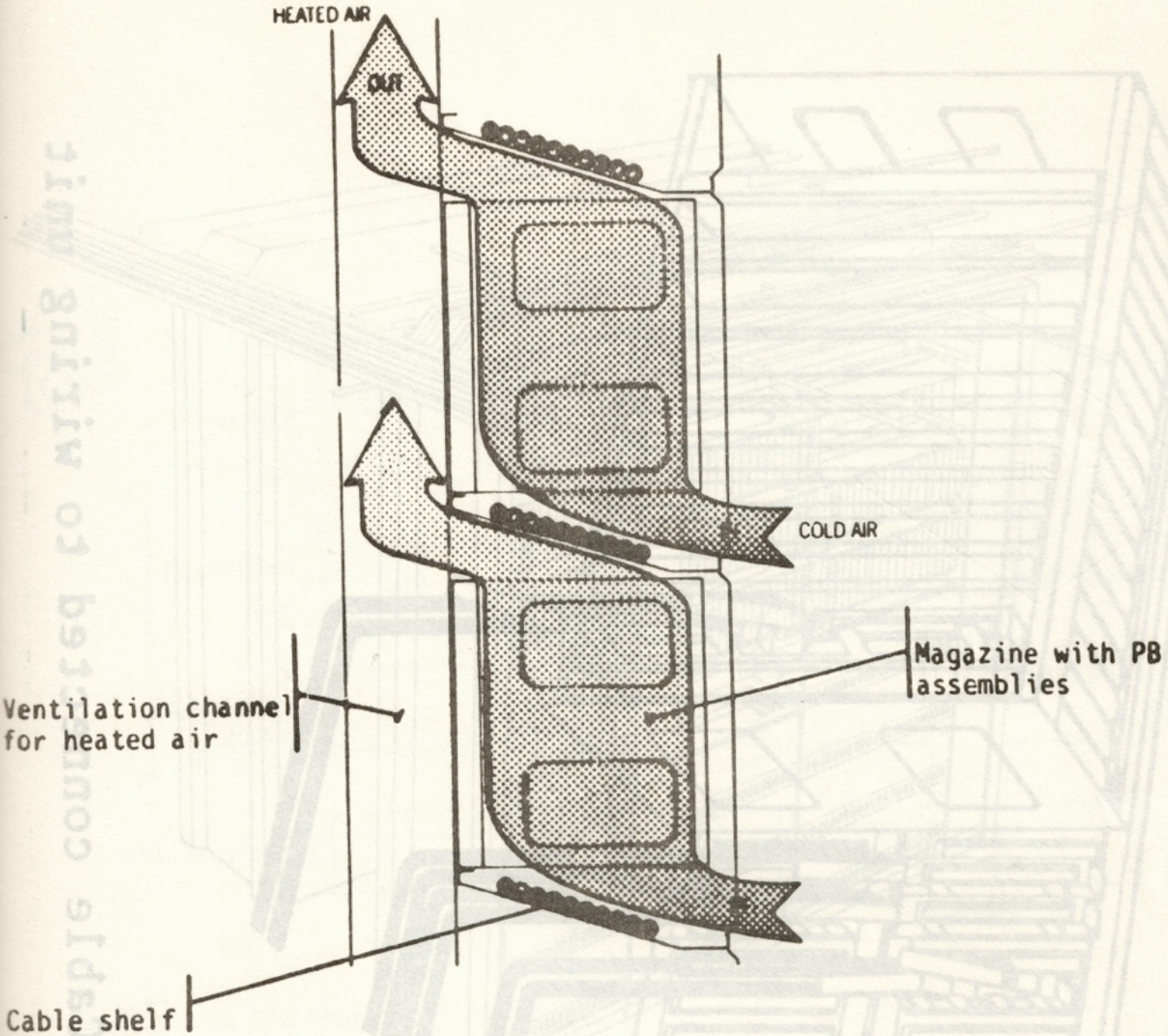



Figure 2.5 The board frame




Parallel cooling

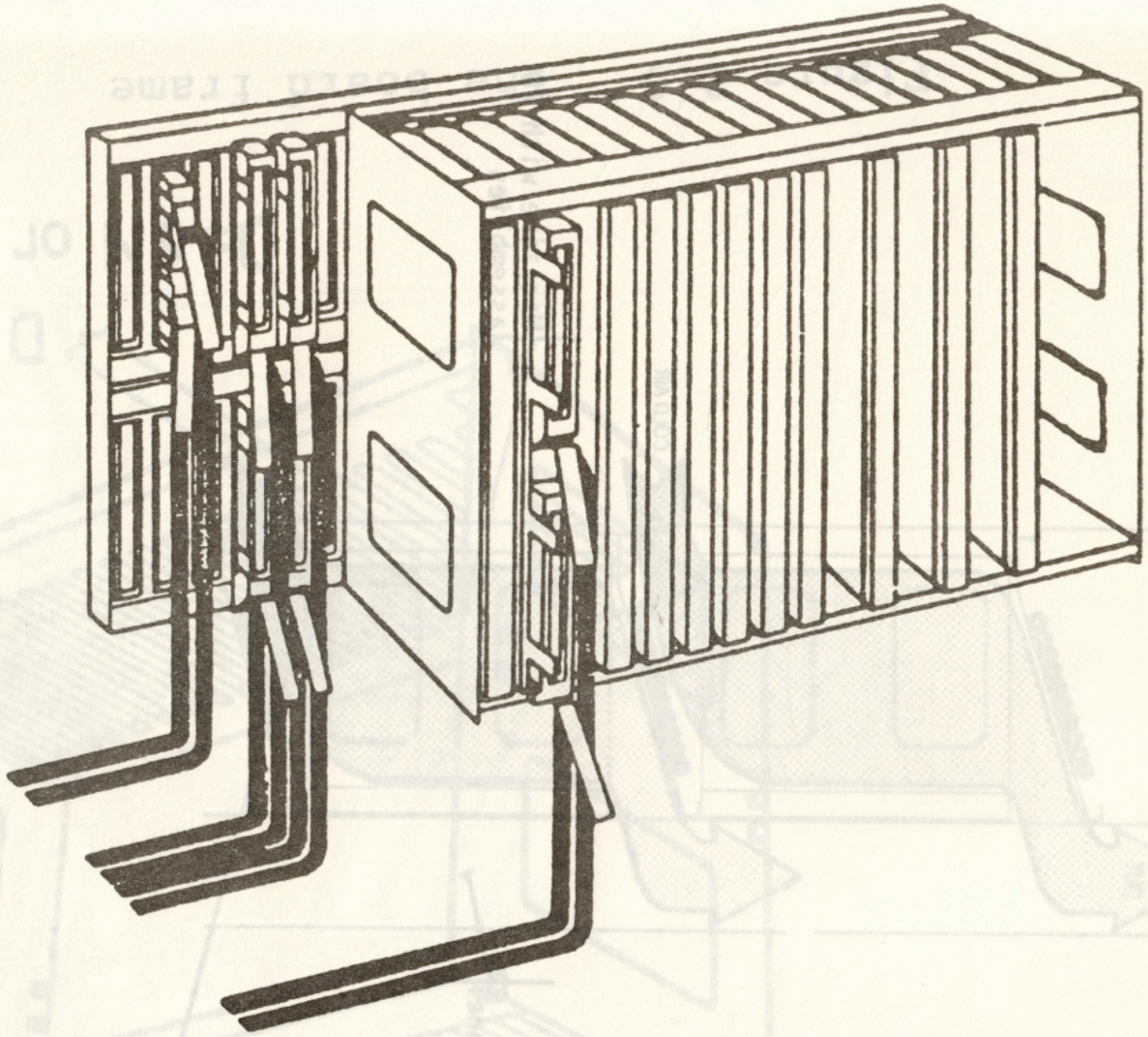
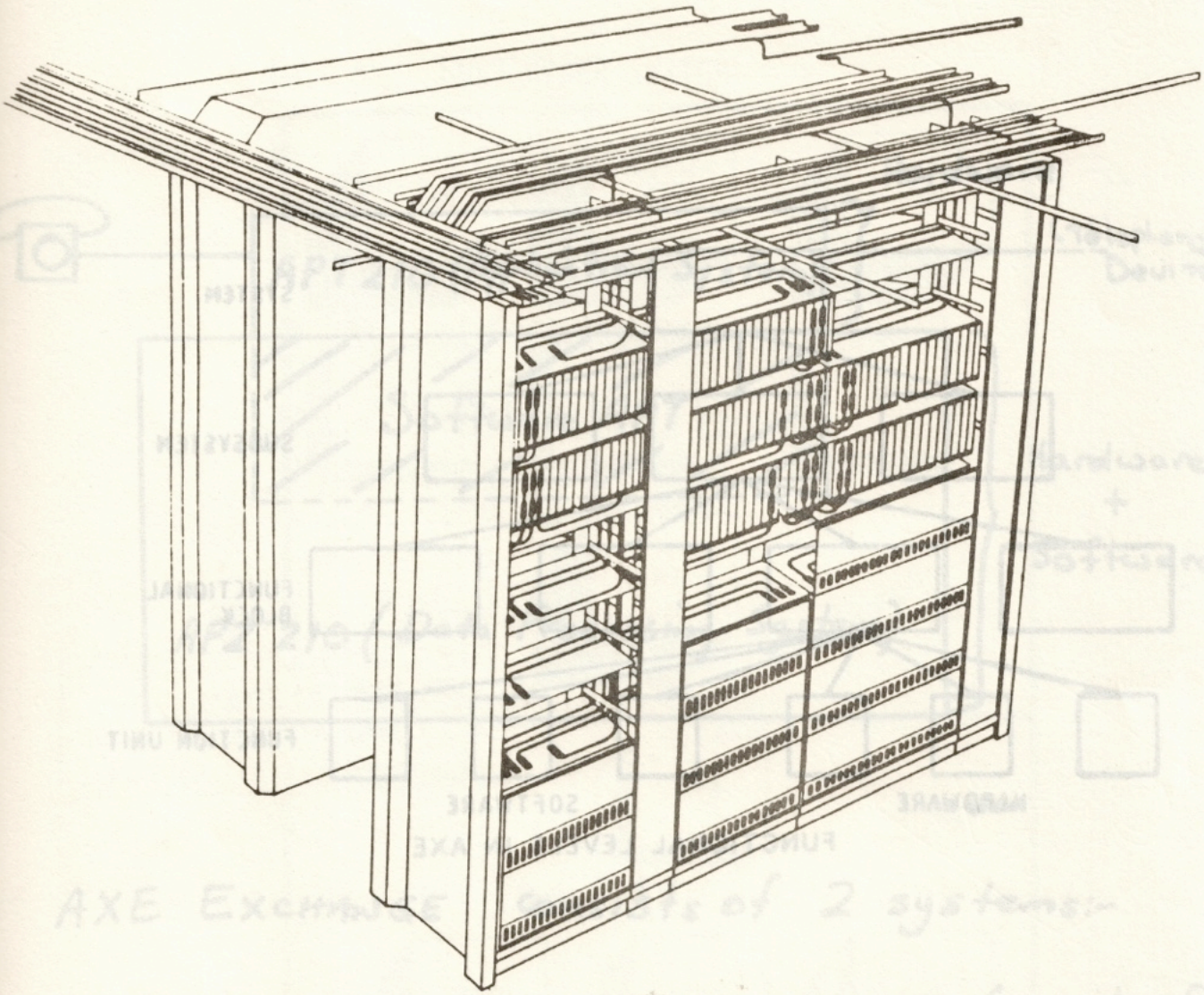
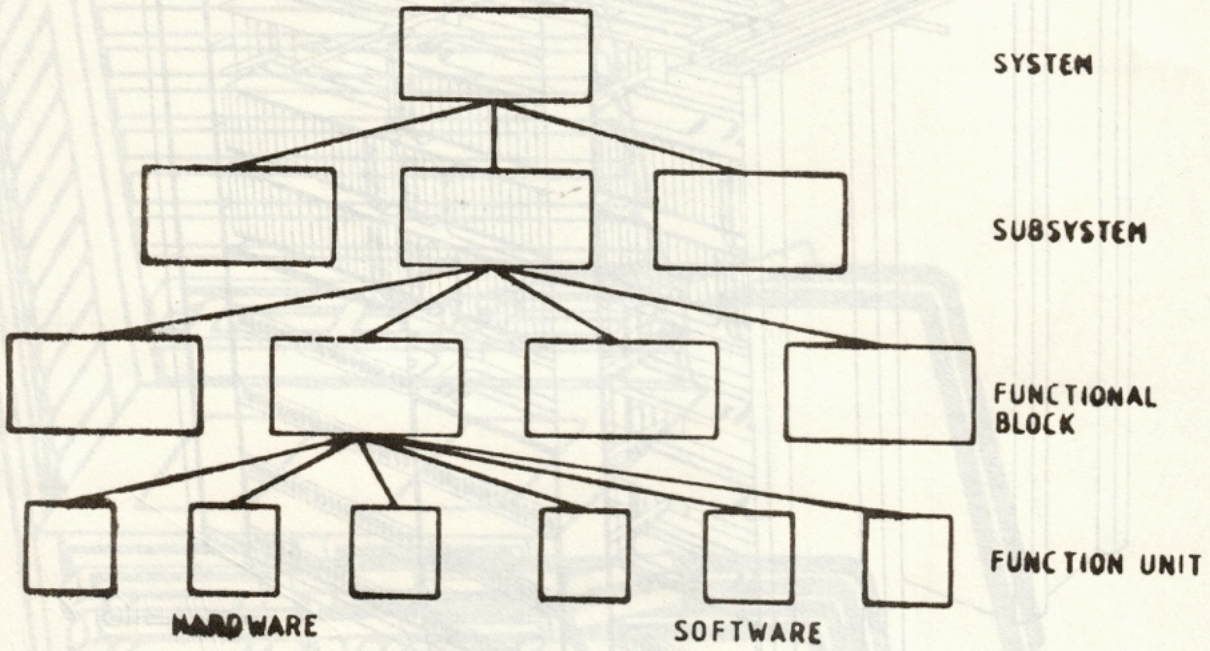
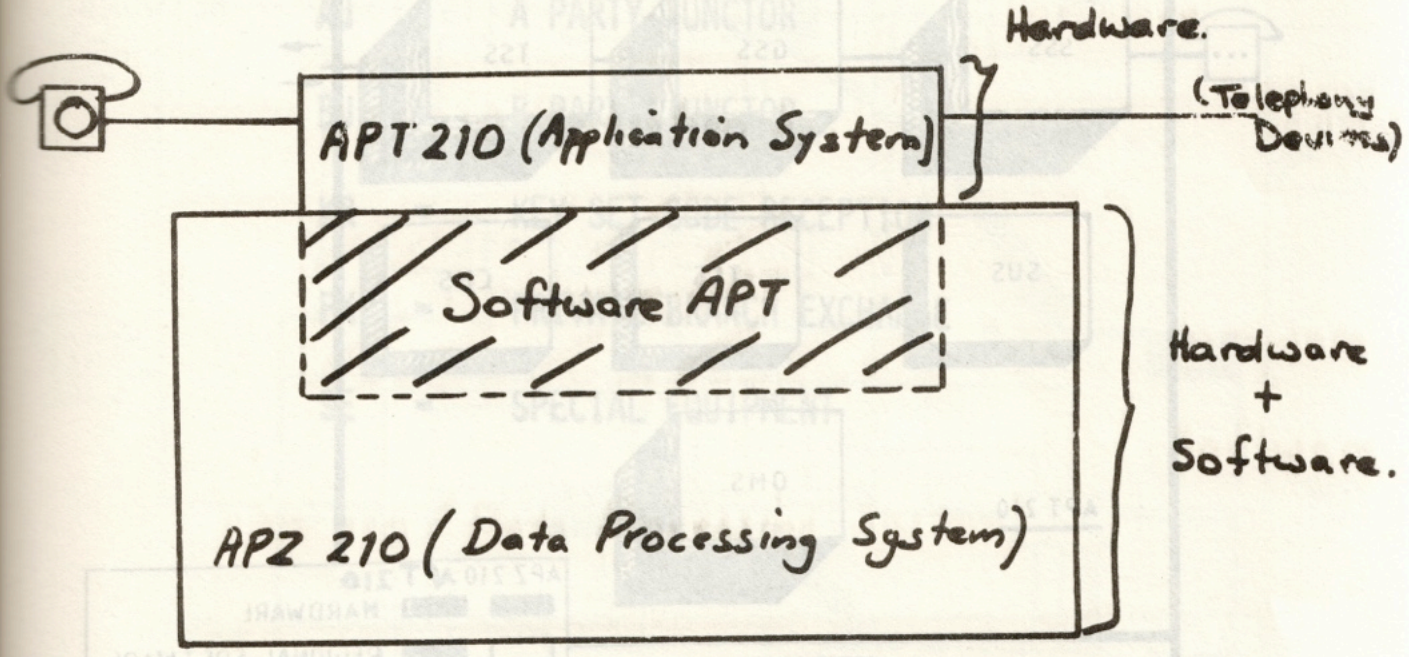


Fig 2.4 Cable connected to wiring unit





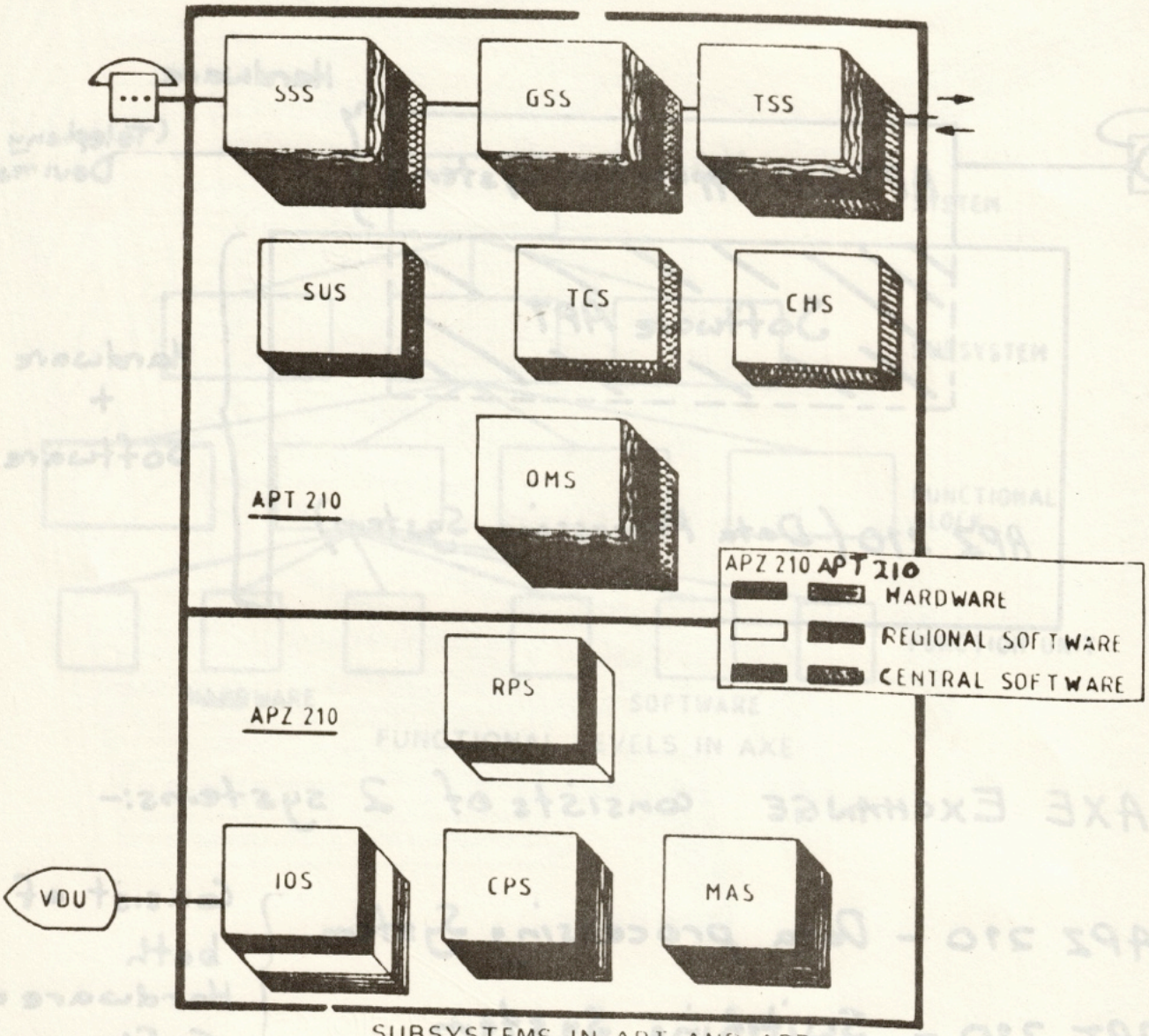

FUNCTIONAL LEVELS IN AXE




AXE EXCHANGE consists of 2 systems:-

APZ 210 - Data processing System. } Consist of both Hardware & Software.

APT 210 - Switching System




SUBSYSTEMS IN APT AND APZ

## FUNCTIONAL BLOCKS

LI = LINE INTERFACE

SS = SUBSCRIBER SWITCH

AJ = A PARTY JUNCTOR

BJ = B PARTY JUNCTOR

KR = KEY SET CODE RECEPTION

PX = PRIVATE BRANCH EXCHANGE

SE = SPECIAL EQUIPMENT

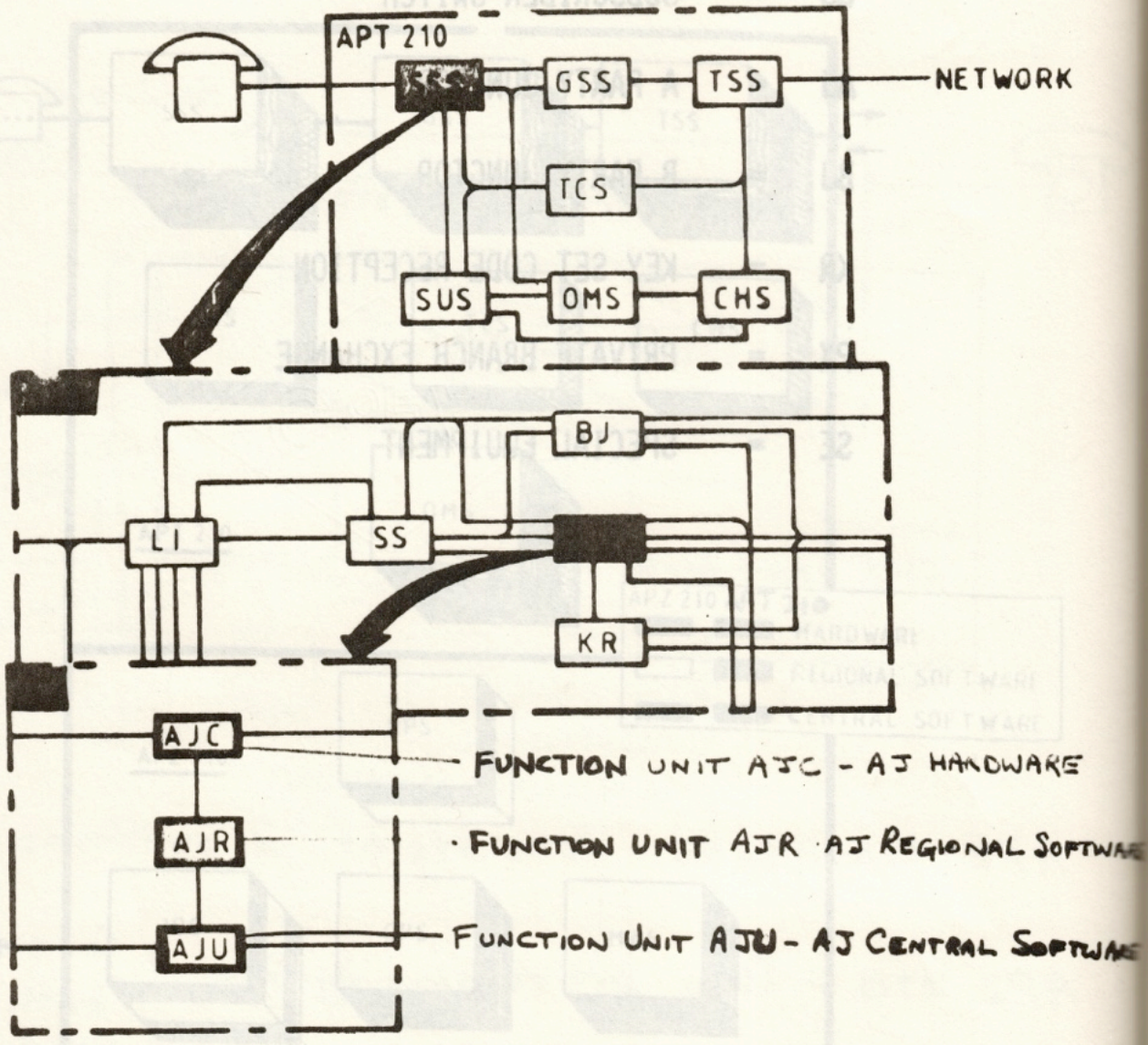
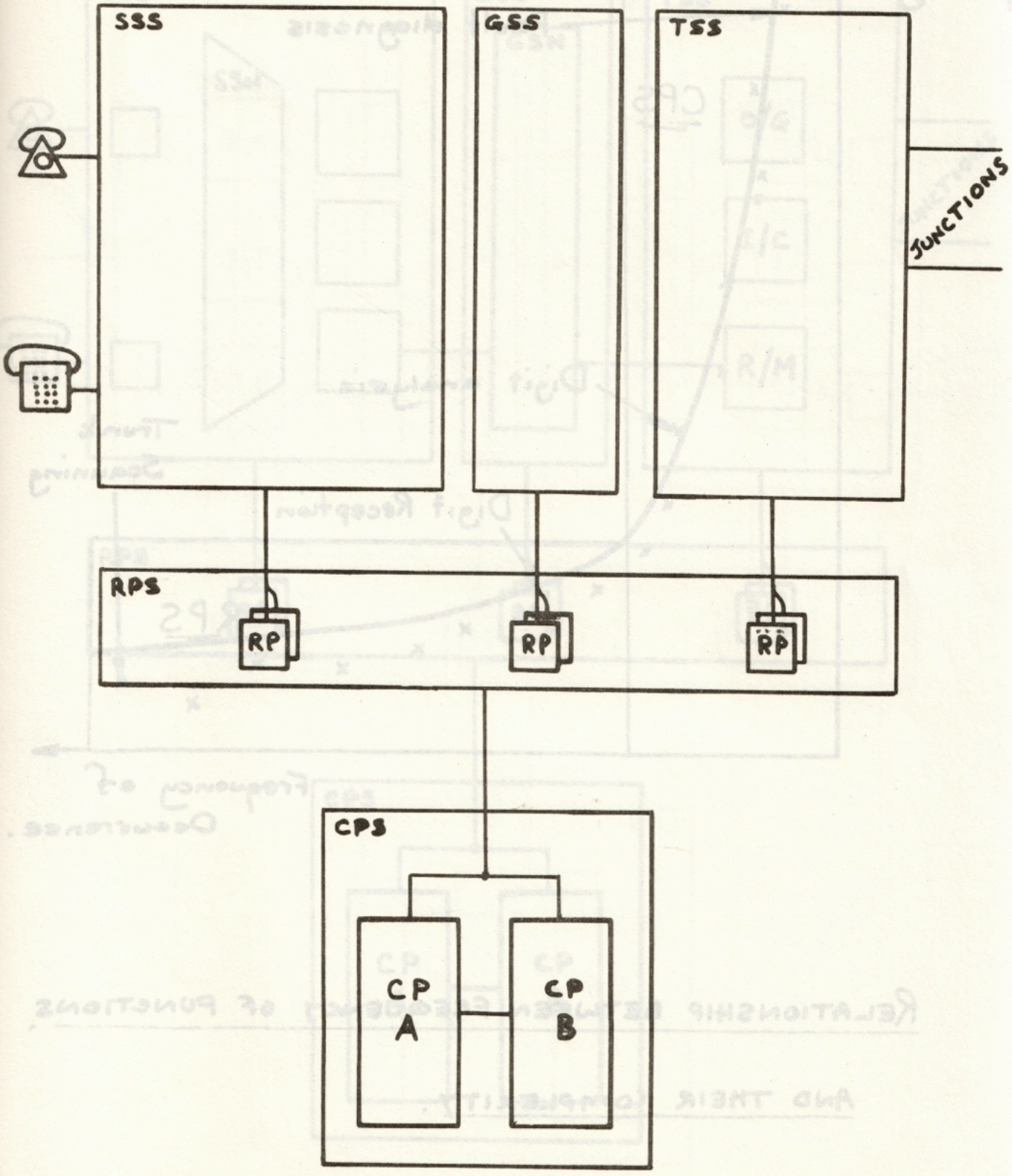
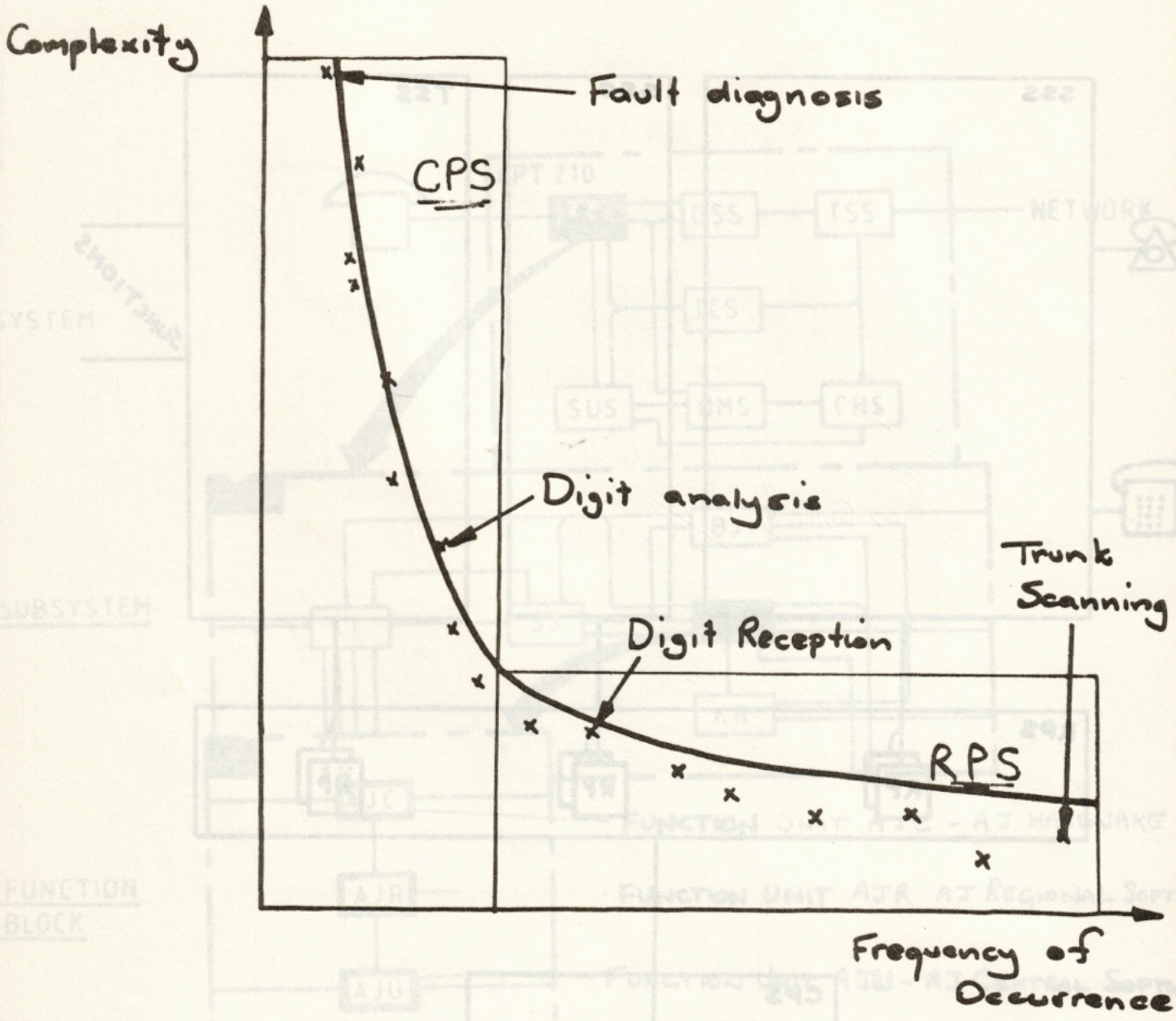
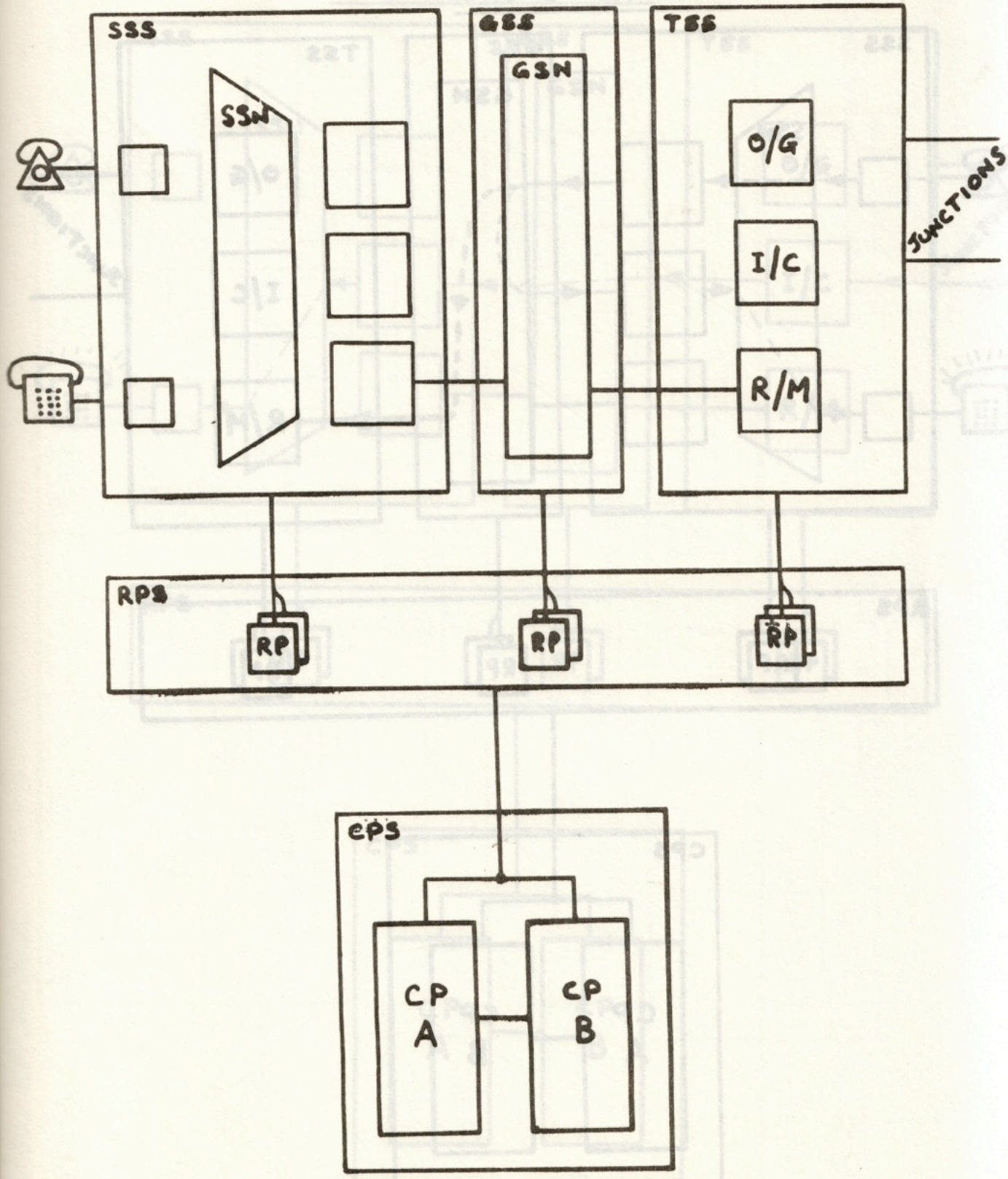



ILLUSTRATION OF FUNCTIONAL STRUCTURE OF APT

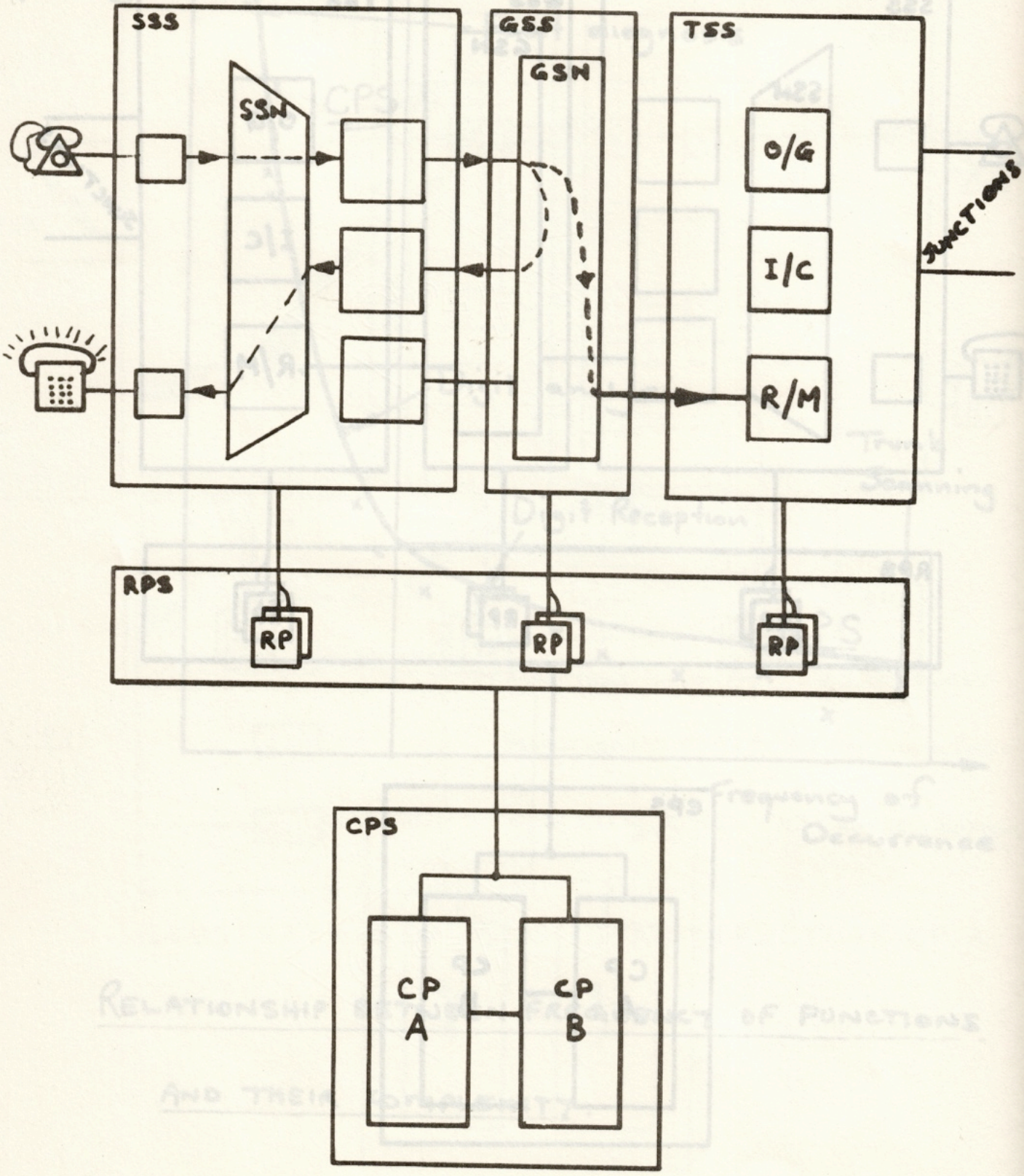

SSS
GSS
TSS
JUNCTIONS
RPS
RP
RP
RP
CPS
CP
A
CP
B



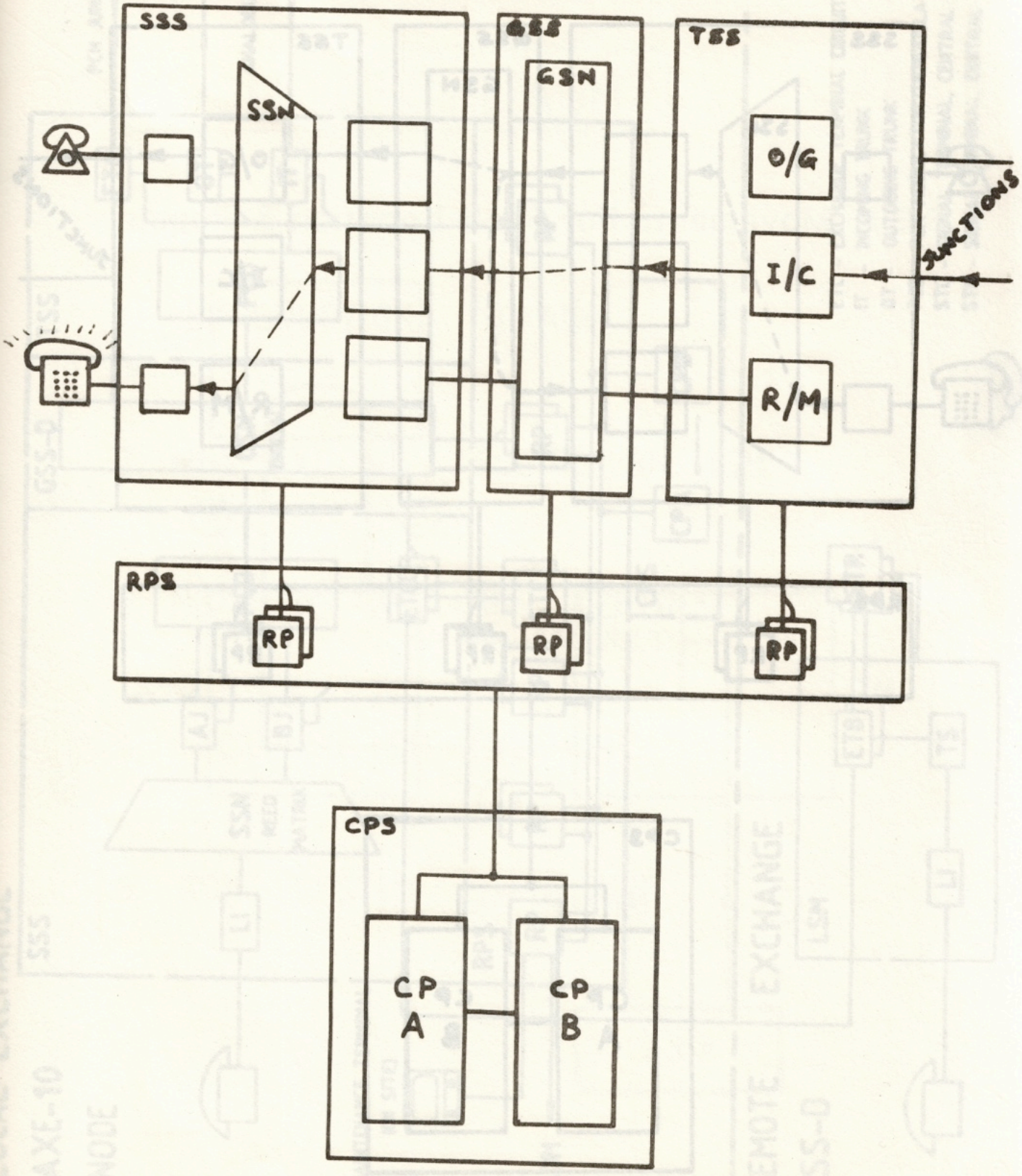

RELATIONSHIP BETWEEN FREQUENCY OF FUNCTIONS AND THEIR COMPLEXITY.


SSS
SSW
GSS
GSN
TSS
O/G
I/C
R/M
JUNCTIONS
RPS
RP
RP
RP
CPS
CP
A
CP
B

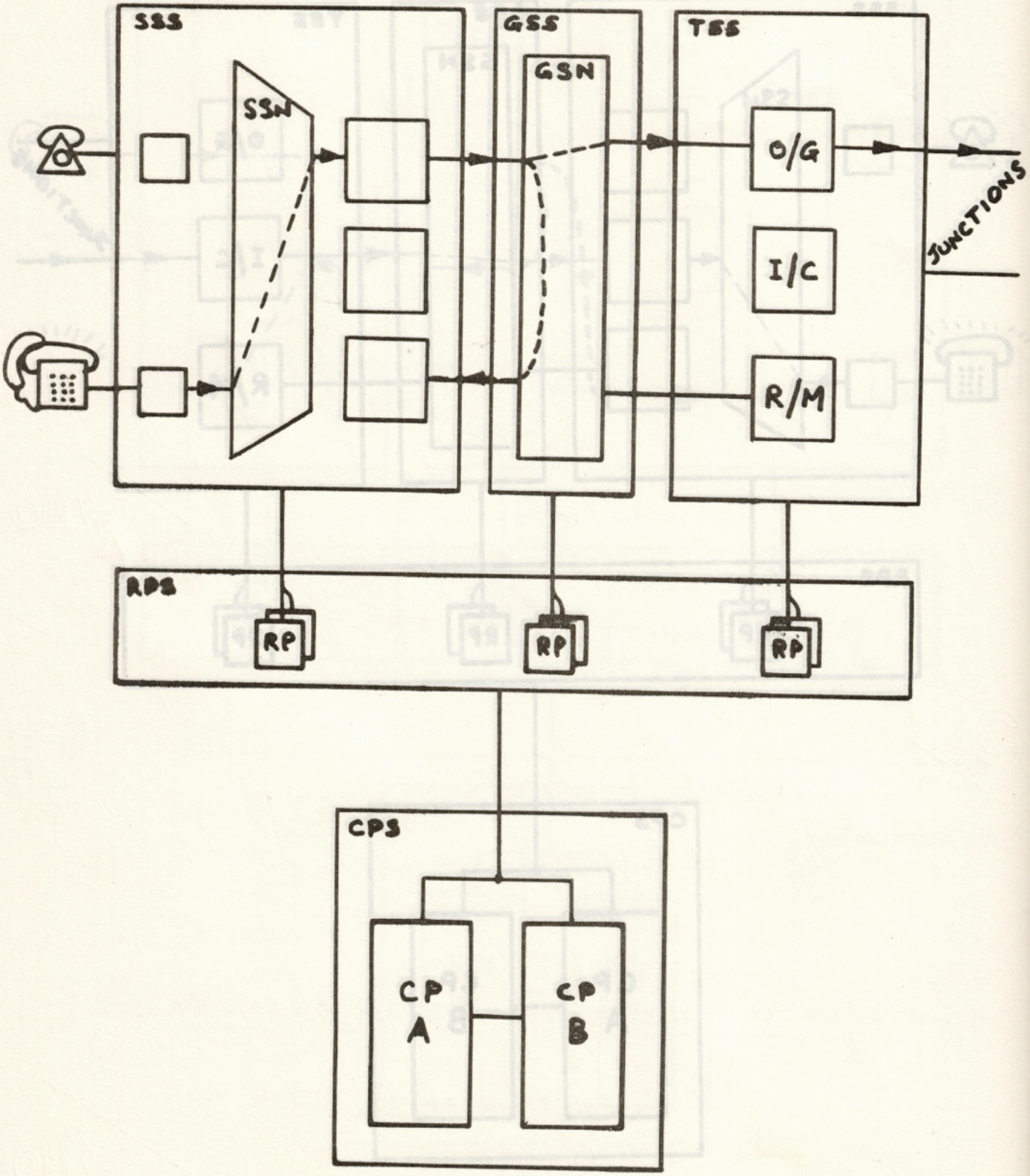
# LOCAL CALL

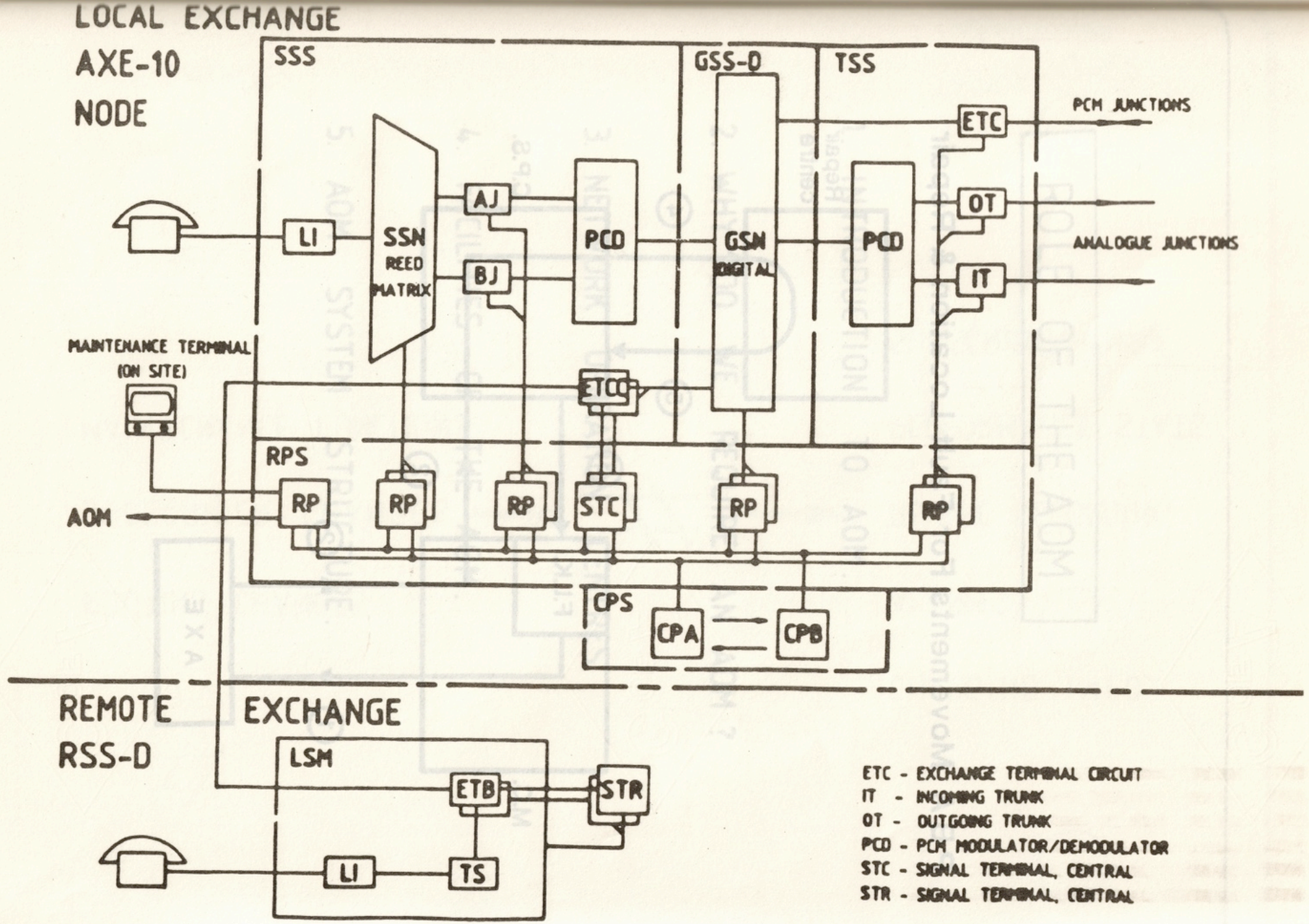


# INCOMING CALL

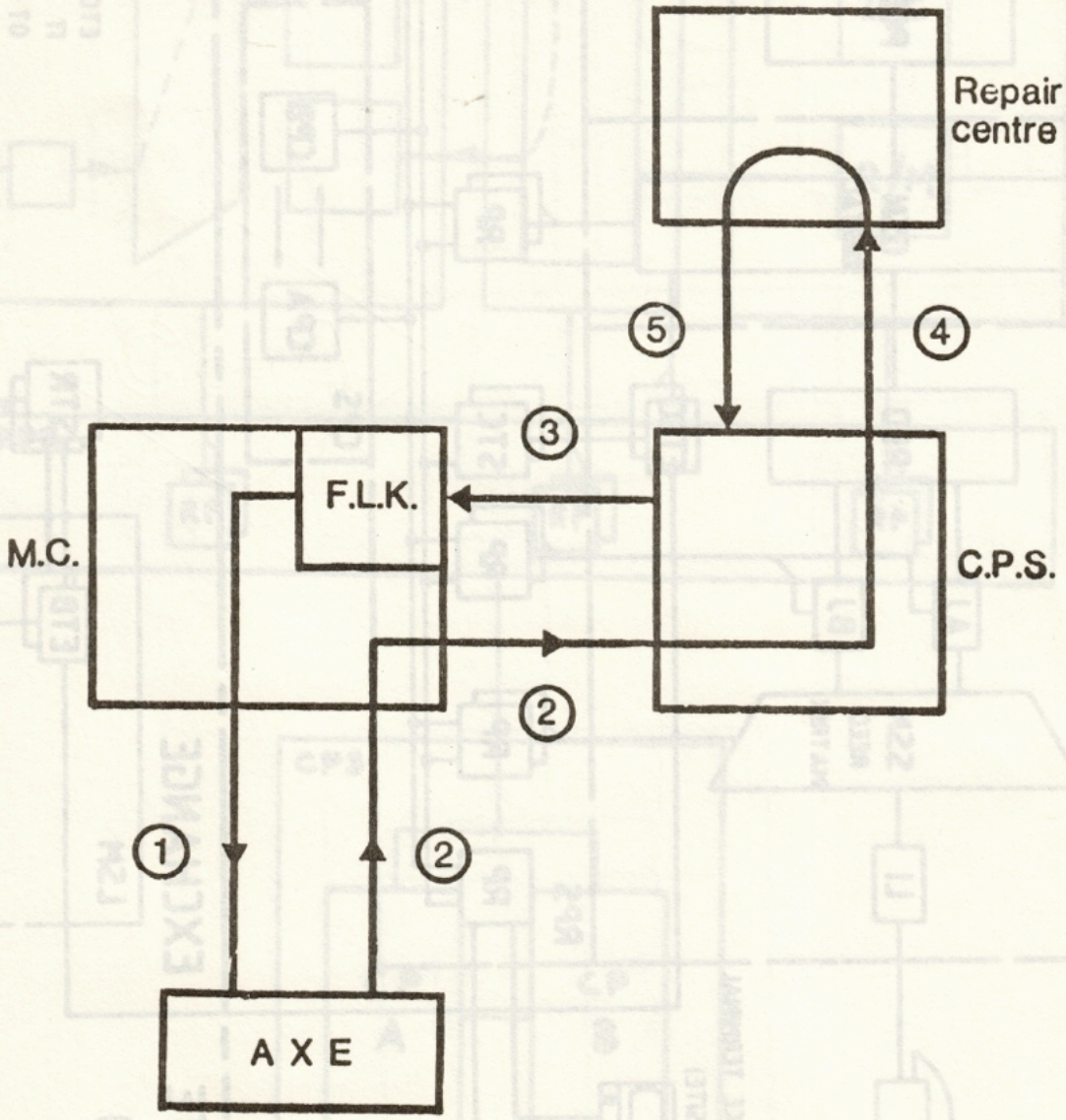


# OUTGOING CALL




LOCAL EXCHANGE
AXE-10
NODE
SSS
GSS-D
TSS
PCM JUNCTIONS
ETC
OT
IT
ANALOGUE JUNCTIONS
LI
SSN
REED
MATRIX
AJ
BJ
PCD
GSN
DIGITAL
PCD
MAINTENANCE TERMINAL
(ON SITE)
ETC
RPS
AOM
RP
RP
RP
STC
RP
RP
CPS
CPA
CPB
REMOTE
RSS-D
EXCHANGE
LSM
ETB
STR
LI
TS
ETC - EXCHANGE TERMINAL CIRCUIT
IT - INCOMING TRUNK
OT - OUTGOING TRUNK
PCD - PCM MODULATOR/DEMODULATOR
STC - SIGNAL TERMINAL, CENTRAL
STR - SIGNAL TERMINAL, CENTRAL

# P B A Movements For Fault Location & Repair



# ROLE OF THE AOM

1. INTRODUCTION TO AOM.

2. WHY DO WE REQUIRE AN AOM ?

3. NETWORK OPERATION CENTRES.

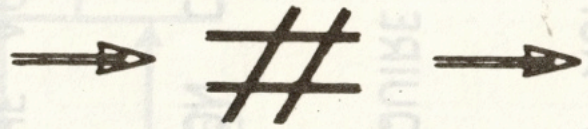
4. FACILITIES OF THE AOM.

5. AOM SYSTEM STRUCTURE.

ROUTING CHANGES

SUBSCRIBER CHANGES

MAINTENANCE FUNCTIONS



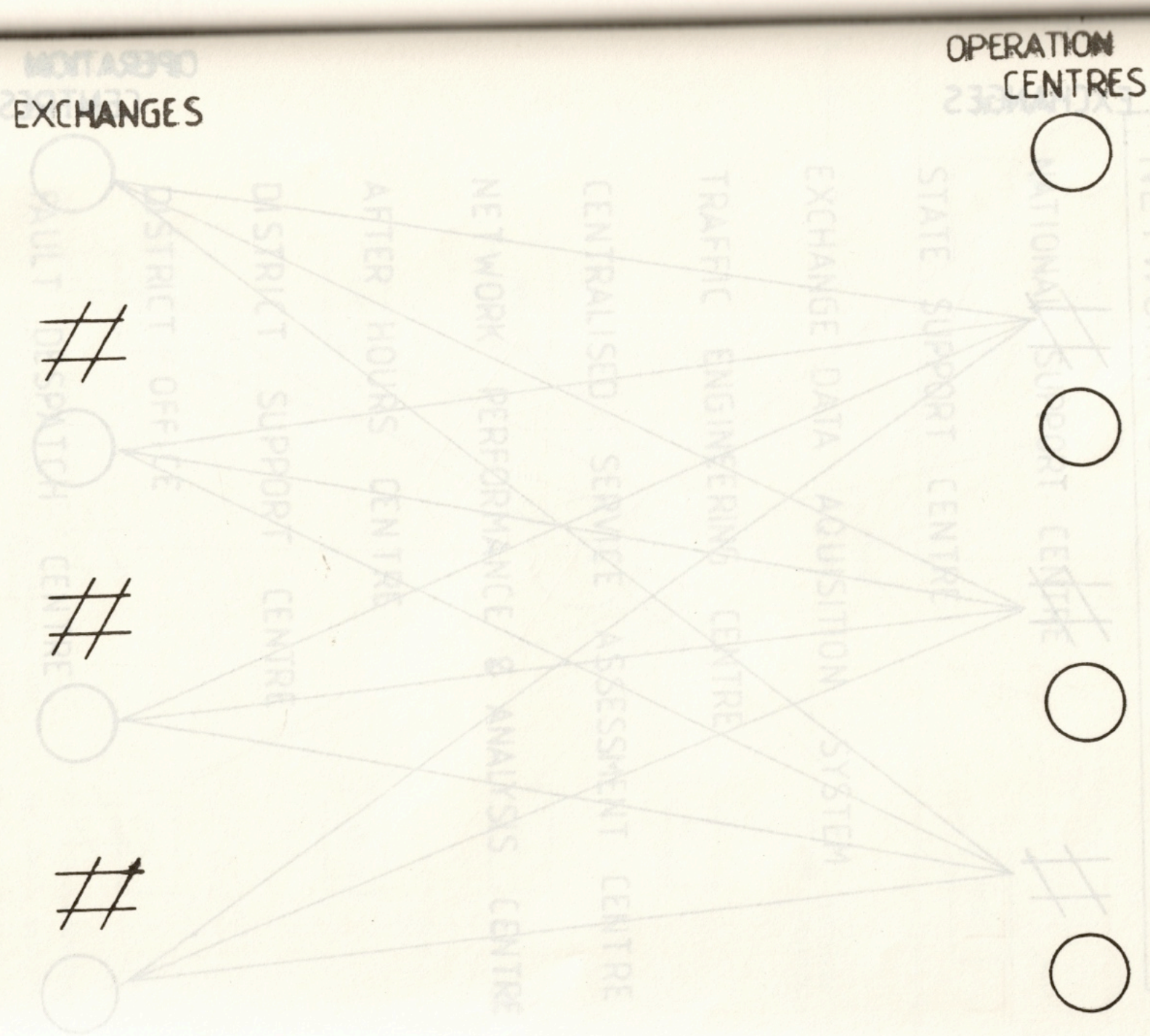
CHARGING INFO.

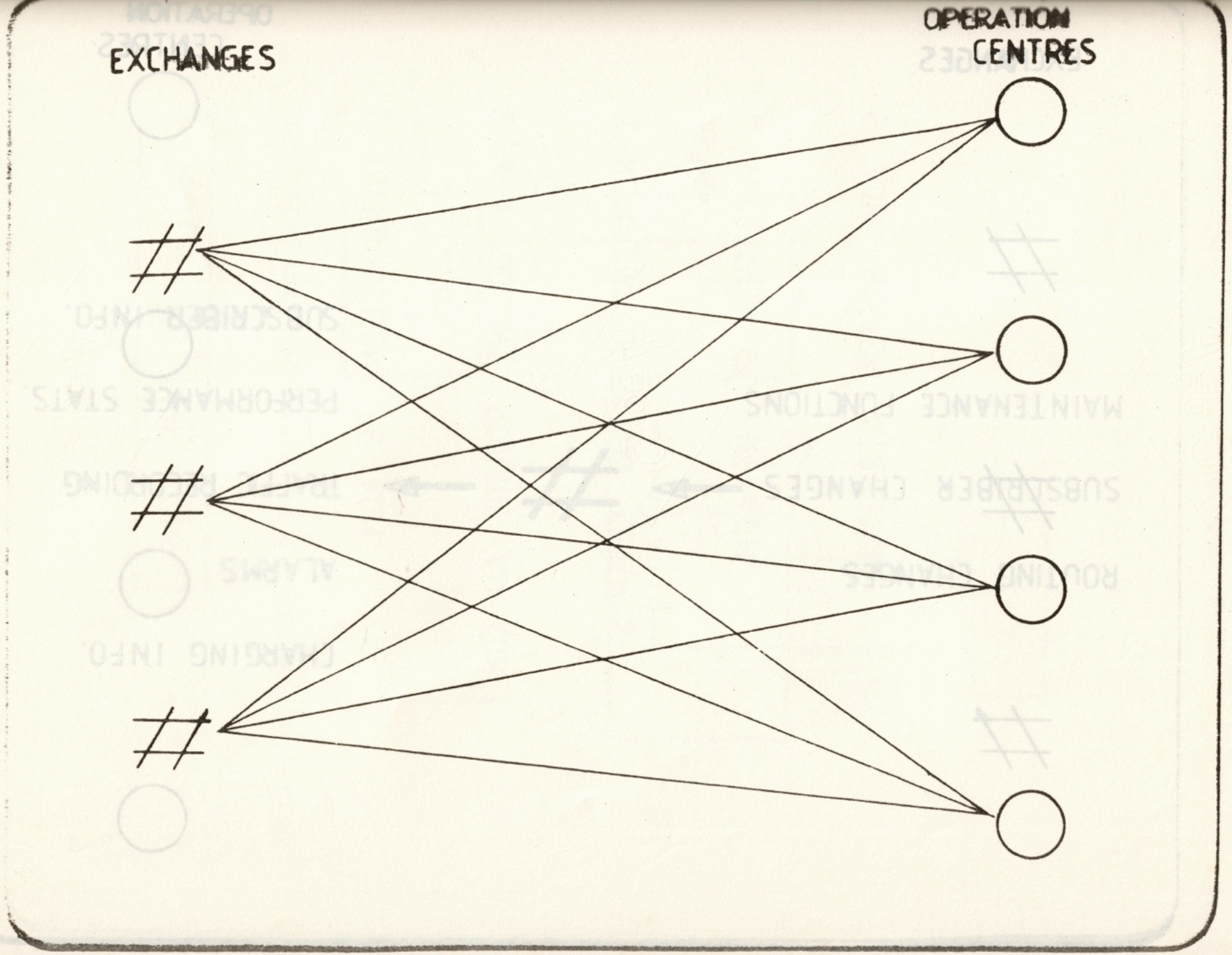
ALARMS

TRAFFIC RECORDING

PERFORMANCE STATS.

SUBSCRIBER INFO.


EXCHANGES
OPERATION CENTRES


EXCHANGES
OPERATION CENTRES

# NETWORK OPERATION CENTRES

NATIONAL SUPPORT CENTRE

STATE SUPPORT CENTRE

EXCHANGE DATA AQUISITION SYSTEM

TRAFFIC ENGINEERING CENTRE

CENTRALISED SERVICE ASSESSMENT CENTRE

NETWORK PERFORMANCE & ANALYSIS CENTRE

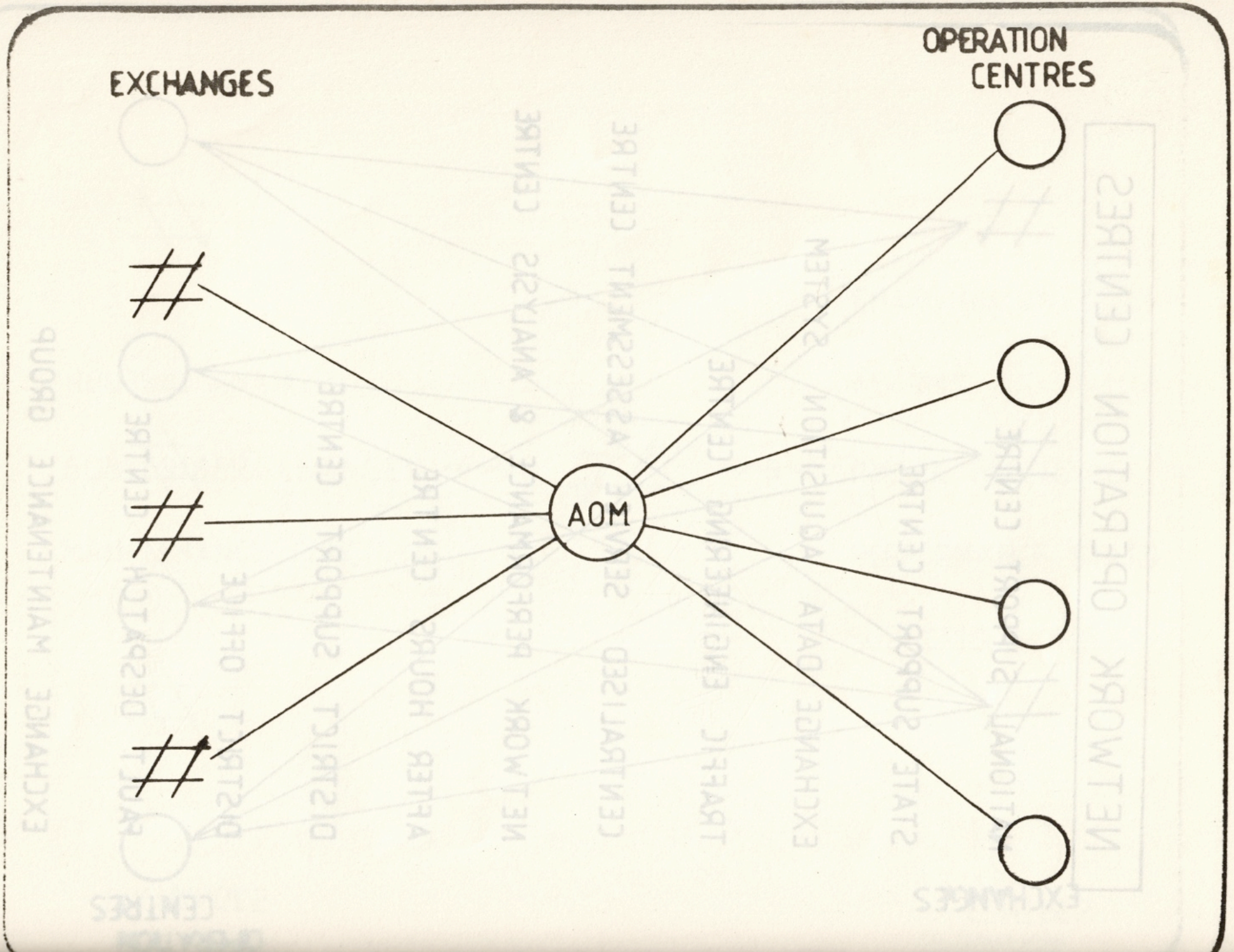
AFTER HOURS CENTRE

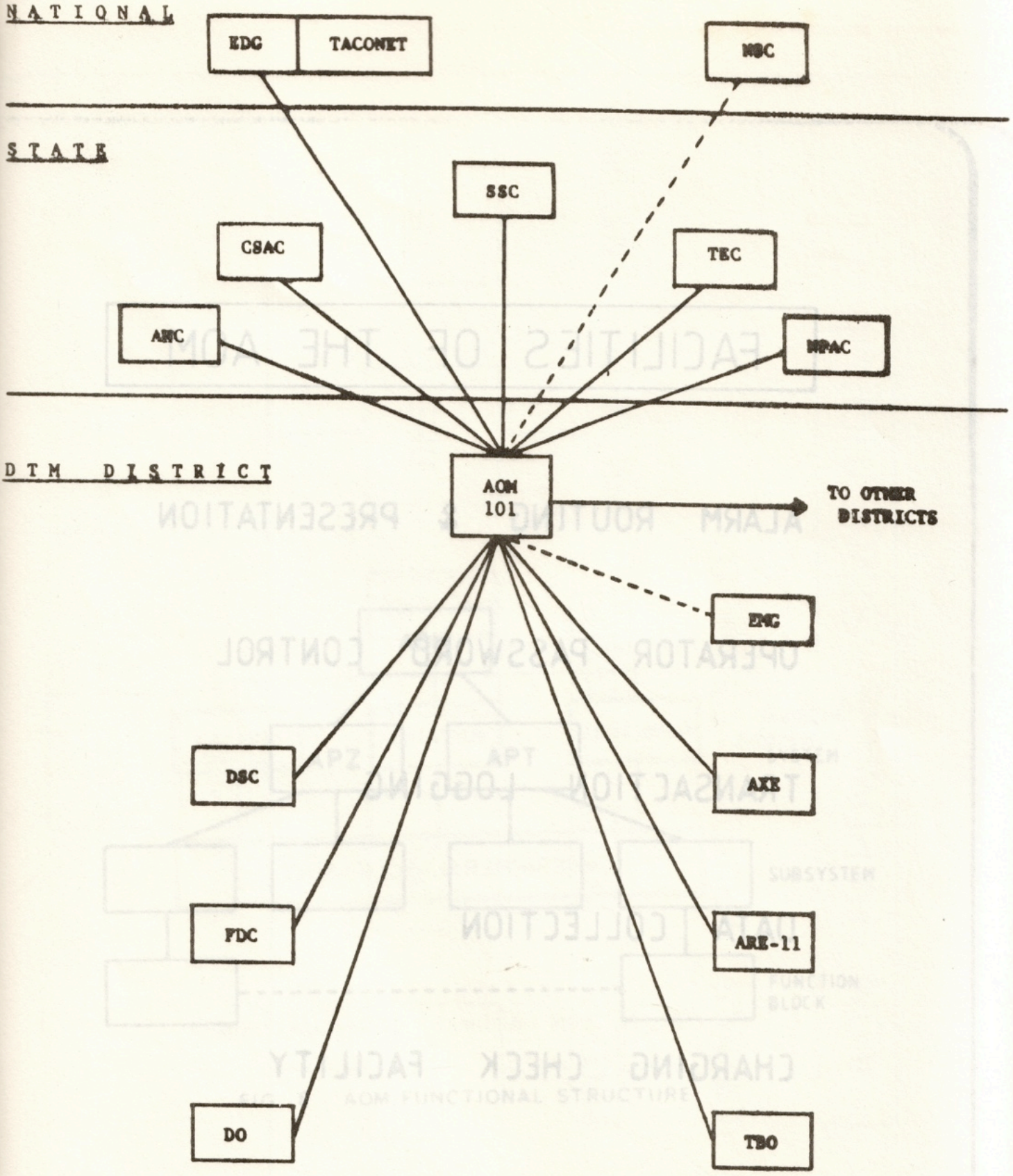
DISTRICT SUPPORT CENTRE

DISTRICT OFFICE

FAULT DESPATCH CENTRE

EXCHANGE MAINTENANCE GROUP


EXCHANGES
OPERATION CENTRES
AOM




LEGEND:

| | | | | | |
|---|---|---|---|---|---|
| AHC | : | After Hours Centre | FDC | : | Fault Despatch Centre |
| CSAC | : | Centralised Service Assessment Centre | NPAC | : | Net. Perf. Analysis Centre |
| DO | : | District Office | NSC | : | National Support Centre |
| DSC | : | District Support Centre | TEC | : | Traffic Eng. Centre |
| EDG | : | Exchange Data Gateway | TBO | : | Telecom. Bus. Office |
| EMG | : | Exchange Maintenance Group | | | |

APPENDIX A : OPERATIONS NETWORK FOR AXE

# FACILITIES OF THE AOM

ALARM ROUTING & PRESENTATION

OPERATOR PASSWORD CONTROL

TRANSACTION LOGGING

DATA COLLECTION

CHARGING CHECK FACILITY

# FACILITIES OF THE AOM

ALARM ROUTING & PRESENTATION

OPERATOR PASSWORD CONTROL

TRANSACTION LOGGING

DATA COLLECTION

CHARGING CHECK FACILITY

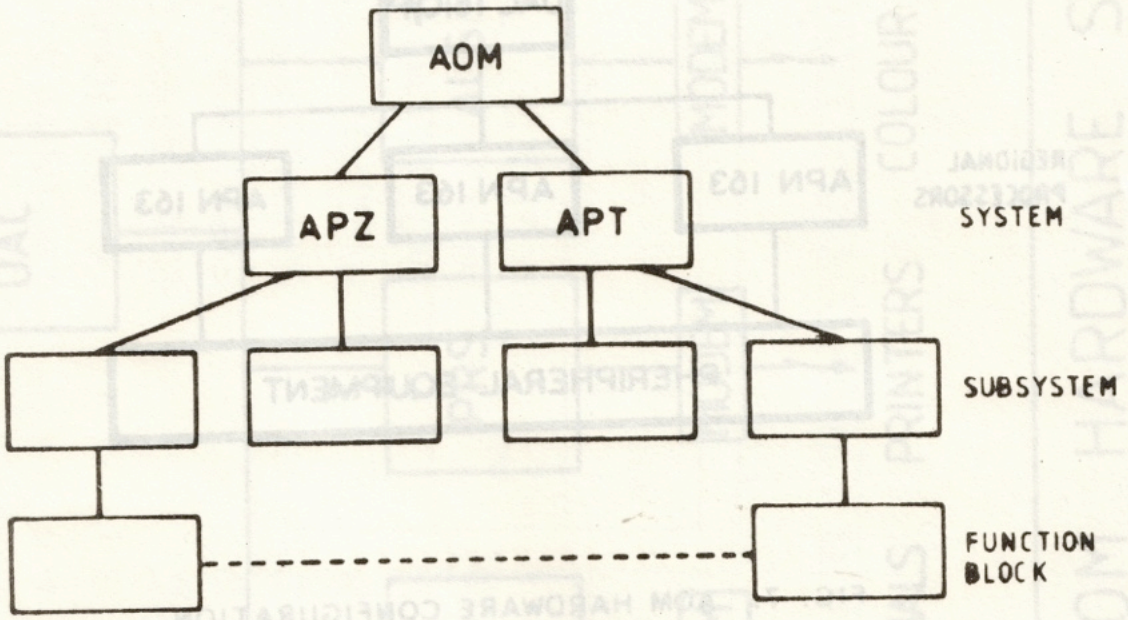



FIG. 8. AOM FUNCTIONAL STRUCTURE

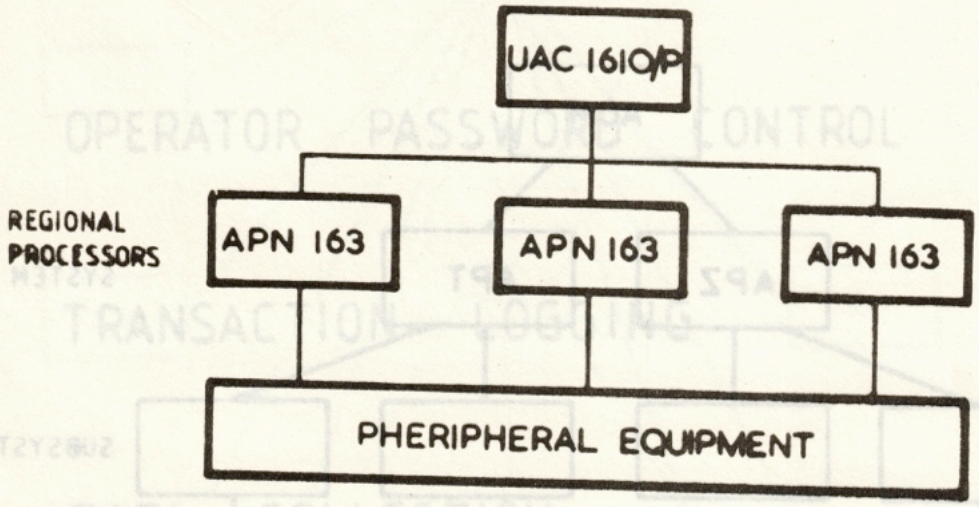
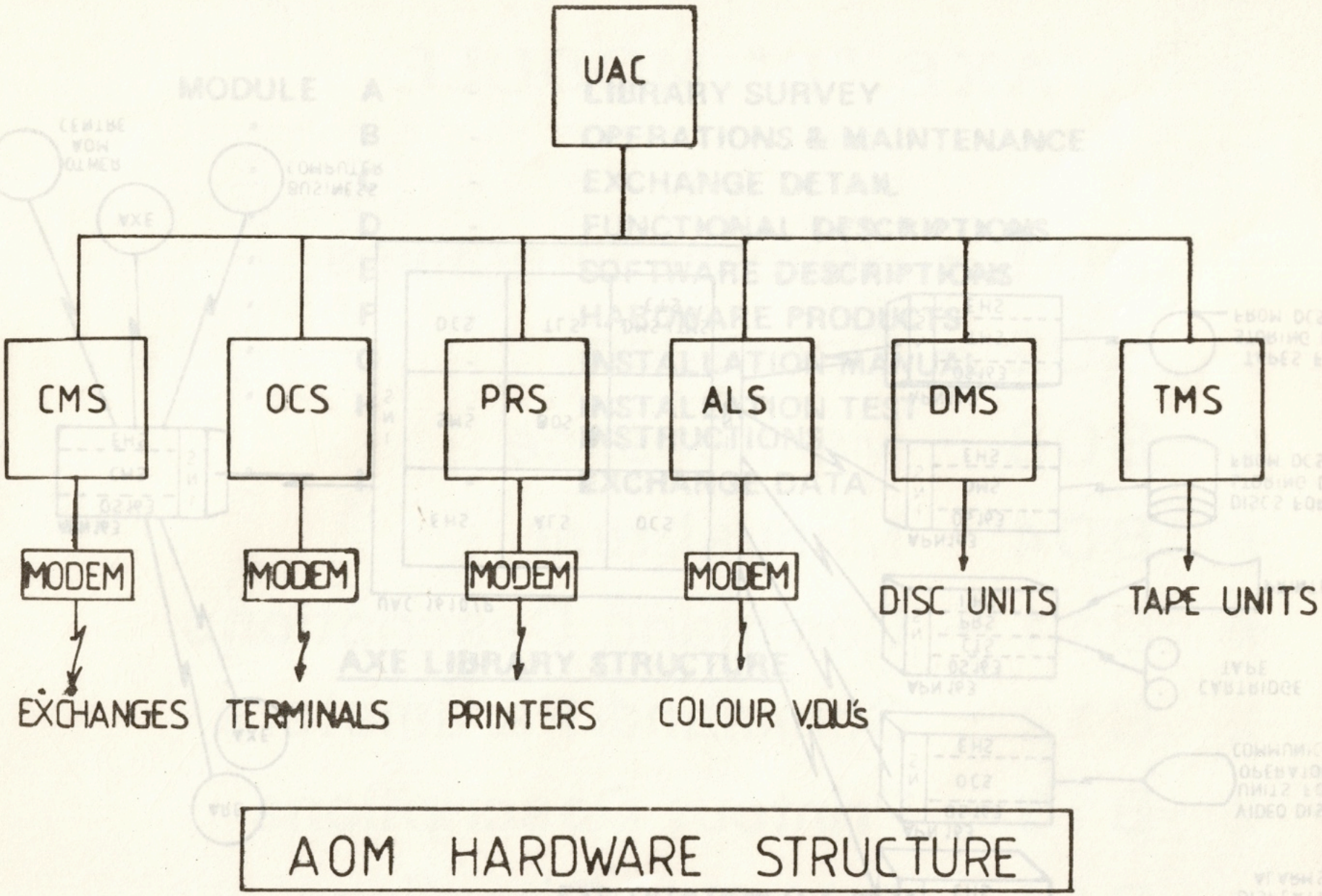
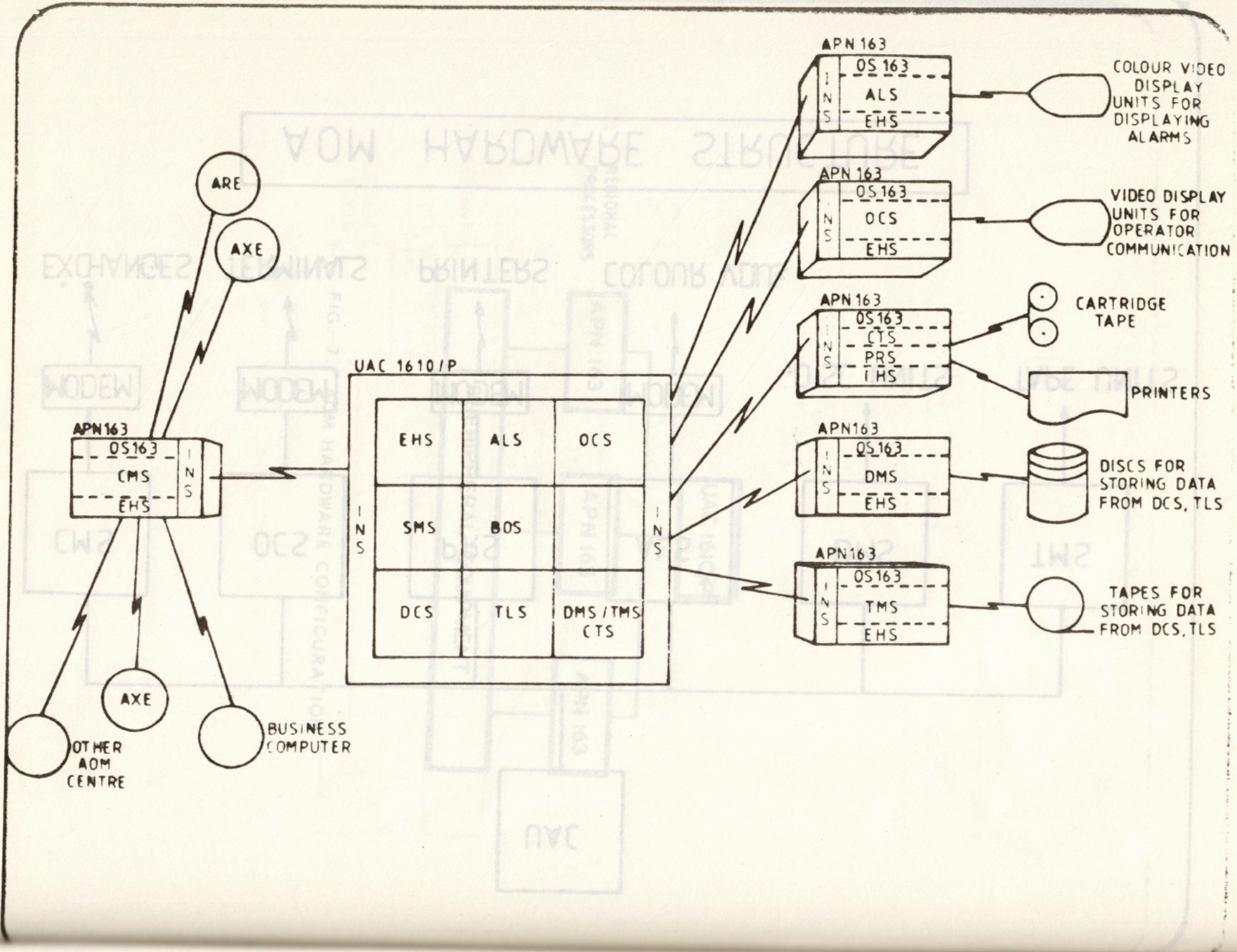



FIG. 7. AOM HARDWARE CONFIGURATION




AOM HARDWARE STRUCTURE


APN 163
OS 163
ALS
EHS
INS
COLOUR VIDEO DISPLAY UNITS FOR DISPLAYING ALARMS
APN 163
OS 163
OCS
EHS
INS
VIDEO DISPLAY UNITS FOR OPERATOR COMMUNICATION
APN 163
OS 163
CTS
PRS
IHS
INS
CARTRIDGE TAPE
PRINTERS
APN163
OS163
DMS
EHS
INS
DISCS FOR STORING DATA FROM DCS, TLS
APN163
OS163
TMS
EHS
INS
TAPES FOR STORING DATA FROM DCS, TLS
UAC 1610/P
EHS
ALS
OCS
SMS
BOS
DCS
TLS
DMS/TMS CTS
INS
INS
APN163
OS163
CMS
EHS
INS
ARE
AXE
AXE
OTHER AOM CENTRE
BUSINESS COMPUTER

| | | | |
|---|---|---|---|
| MODULE | A | - | LIBRARY SURVEY |
| ' | B | - | OPERATIONS & MAINTENANCE |
| ' | C | - | EXCHANGE DETAIL |
| ' | D | - | FUNCTIONAL DESCRIPTIONS |
| ' | E | - | SOFTWARE DESCRIPTIONS |
| ' | F | - | HARDWARE PRODUCTS |
| ' | G | - | INSTALLATION MANUAL |
| ' | H | - | INSTALLATION TEST INSTRUCTIONS |
| ' | I | - | EXCHANGE DATA |

## AXE LIBRARY STRUCTURE

# AXE "B" MODULE

* B01 - General Directives
* B02 - Operation
* B03 - Maintenance
* B04 - Manual test
* B11 - Command Descriptions
* B12 - Command Parameters
* B13 - Printout Descriptions
* B14 - Adaption Directions

TO ANTICIPATE COMMERCIAL PRESSURE ,HQ HAS BEEN ACCELERATING POLICY RELEASES AIMED AT NETWORK MODERNISATION.

POLICIES APPROVED SINCE JAN 1982:-

* DIGITAL SUBSCRIBERS STAGE FOR AXE
* DIGITAL RADIO FOR JUNCTIONS
* DIGITAL TRANSMISSION FOR COAXIAL CABLE
* OPTICAL FIBRE SYSTEMS
* NATIONAL IDN
* DIGITAL RADIO FOR TRUNK NETWORK
* DIGITAL SWITCHING FOR TRUNK NETWORK
* COMMON CHANNEL SIGNALLING
* ISDN STRATEGY
* DIGITAL NETWORK SYNCHRONISATION

# WHY AXE ?

## AXE PROVIDES MANY BENEFITS:-

* INCREASED CUSTOMER FACILITIES
* REDUCED BUILDING REQUIREMENTS
* IMPROVED MAINTENANCE PRODUCTIVITY
* IMPROVED INSTALLATION PRODUCTIVITY
* UNSTAFFED EXCHANGES
* FACILITATES PRE-WIRED MDF'S
* MORE EFFICIENT USE OF NETWORK
  - -DIGITAL (GSS-D)
  - -REMOTE SUBSCRIBER STAGE (RSS)
* IMPROVED CONTROL OF OPERATION & MAINTENANCE
  - -AOM
  - -NOC'S
* MAY BE USED AS A TERMINAL OR TANDEM EXCHANGE
  - -DIGITAL TANDEM

| FACILITY | SXS | ARK | ARF | ARE | AXE |
|---|---|---|---|---|---|
| NETWORK CONFERENCING | * | * | * | * | * |
| CENTRAL INTERCEPTION | | | * | * | * |
| CALLING LINE IDENTIFICATION | | | * | * | * |
| ISD / CCR | | | * | * | * |
| STD / CCR | | | * | * | * |
| RING BACK PRICING | | | * | * | * |
| INCREASED SUBS CLASSIFICATION | | | * | * | * |
| REMOTE CLASSIFICATION OF SUBS | | | | * | * |
| VF PUSH BUTTON TELEPHONES | | | | * | * |
| ABBREVIATED DIALLING | | | | * | * |
| HOT LINE | | | | * | * |
| HOT LINE WITH NORMAL DIALING | | | | * | * |
| THREE WAY CONFERENCE CALLS | | | | | * |
| THIRD PARTY ENQUIRY | | | | | * |
| CALL DIVERSION | | | | | * |
| CALL WAITING | | | | | * |
| SUBS CONTROL OF ACCESS | | | | | * |
| AUTO REMINDER CALL | | | | | * |
| AUTO REDIAL | | | | | * |
| DO NOT DISTURB | | | | | * |
| PRIORITY CALLING | | | | | * |
| "64 kbit/s" SERVICES | | | | | * |

# CUSTOMER FACILITIES

# DEVELOPMENT

| | |
|---|---|
| 1970'S | NEED FOR SPC LOCAL,<br>UPGRADE CROSSBAR |
| 1974 | SPC TRUNK (10C) INTRODUCED<br>WORLDWIDE TENDER FOR SPC LOCAL |
| 1977 | AXE SELECTED |
| 1980 | IDN POLICY FOR URBAN NETWORKS |
| 1981 | FIRST AXE IN AUSTRALIAN NETWORK |

# OVERVIEW OF AXE PROGRAMME
# KEY QUANTITIES AND NETWORK FACILITIES

| | | |
|---|---|---|
| ENDEAVOUR HILLS | TERM EXCH<br>4K LINES | ANALOGUE GSS<br>APZ 210 03 |
| 1ST BULK ORDER 1981/82 | 3 TERM EXCHS<br>11K LINES | DIGITAL GSS<br>APZ 210 03 |
| 2ND BULK ORDER 1982/83 | 15 LOCAL/TANDEM<br>1 TANDEM<br>65K LINES<br>18K TRANSIT | DIGITAL GSS<br>APZ 210 06<br>IDN CONNECTION<br>TANDEM SWITCHING |
| 3RD BULK ORDER 1983/84 | 28 LOCAL/TANDEM<br>2 TANDEM<br>5 RSS<br>105K LINES<br>45K TRANSIT | DIGITAL GSS<br>APZ 210 06<br>IDN CONNECTION<br>TANDEM SWITCHING<br>RSS<br>STD / MM |

# OVERVIEW OF AXE PROGRAMME
# KEY QUANTITIES AND NETWORK FACILITIES

| | | |
|---|---|---|
| 4TH BULK ORDER 1984/85 | 42 LOCAL/TANDEM | DIGITAL GSS |
| (ESTIMATED) | 4 TANDEM | APX 210 06 |
| | 35 RSS | IDN CONNECTION |
| | 150K LINES | TANDEM SWITCHING |
| | 90K TRANSIT | RSS |
| | | STD/CCR/DDT |
| | | SSN |
| | | PORTABLE RSS |
| | | STD/MM |

# OVERVIEW OF AXE PROGRAMME
# KEY QUANTITIES AND NETWORK FACILITIES

5TH BULK ORDER 1985/86
(ESTIMATED)

50 LOCAL TANDEM
3 TANDEMS
50 RSS
220K LINES
100K TRANSIT

DIDITAL GSS
APZ 210 06
IDN CONNECTION
TANDEM SWITCHING
RSS
STD/MM
STD/CCR
SSN
PORTABLE RSS
APZ 211
APZ 212
SSS DIGITAL
STD/CCR/LOCAL
ISD/MM/CCR
ECHO SUPRESSOR
COMMON CH SIG
2 Mb/s PABX
64 Kb/s CONN.

## Central processor for AXE 10

| | APZ 210 | APZ 211 | APZ 212 |
|---|---|---|---|
| Call handling capacity, BHCA | 144 000 | 150 000 | 800 000 |
| Mean instruction time, µs | 3.2 | 2.9 | 0.75 |
| Number of software blocks | 4096 | 4096 | 4096 |
| Block size in kwords of 16 bits per word | 16 | 16 | 32 |
| Number of signals/block | 4095 | 4095 | 4095 |
| Number of RPs | 512 | 512 | 1024 |
| Memory capacity<br>DS (Mwords of 16 bits)<br>PS (Mwords of 16 bits)<br>RS | <br>8<br>4<br>256 kwords 32 bits | <br><br>16 (DS+PS+RS) | <br>64<br>32<br>1 024 kwords 40 bits |
| Per printed board assembly (kwords) | 64 | 256 | 512 |
| Relative floor space | 1.0 | 0.12 | 0.42 |
| Power consumption, W, for a typical exchange | 3200 | 350 | 1700 |
| Fan cooling | yes | no | yes |
| Construction practice | row | row, cabinet | cabinet |
| Printed circuit boards | ROF 13 (222×178 mm)<br>ROF 16 (344×399 mm)<br>Glass epoxy<br>2-layer printed boards and wirewrapped boards<br>Hole mounting | ROF 13<br><br>Glass epoxy<br>4-layer printed boards<br>Hole mounting | ROF 13<br><br>Metal base<br>4-layer printed boards<br>Surface mounting |
| Components<br>–logic | TTL74, 74LS, 74S | TTL74F, CMOS<br>Gate matrices<br>TTL bit-slice-processors<br>Microprocessors | TTL74F<br>Gate matrices<br><br>Microprocessors |
| –memory | DRAM 16 (64) kbits<br><br>SRAM, PROM | DRAM 64 (256) kbits<br><br>SRAM, PROM, EPROM | DRAM 64 (256) kbits<br>SRAM, PROM, EPROM |

ARE/AXE/AOM STATE SUPPORT CENTRE
4TH FLOOR, COLLINS TOWER
35 COLLINS STREET
MELBOURNE 3000

TELEX : 34800
FIELD SUPPORT HOTLINE : 657 3046
OUT OF AREA NUMBER : 654 3092

| | | |
|---|---|---|
| Manager | R. Howarth (Dick) | 657 2997 |
| Section Clerk | P. Curley (Pat) | 657 3037 |
| PTO | A. Way (Allan) | 657 3043 |
| STO3, Field Support | B. Edwards (Brian) | 657 3039 |
| Clerical Assistant Grade 4 | A. Ramnac (Angelo) | 657 3049 |
| Clerical Assistant Grade 2 | J. Windram (Jan) | 657 3016 |
| Typist Grade 3 | M. Sword (Maree) | 657 3015 |

AXE/AOM

| | | |
|---|---|---|
| E4, AXE/AOM Co-ord | I. Comport (Ian) | 657 3482 |
| E3, Field Support | M. McDonald (Mal) | 657 3013 |
| E3, Syst. Support | S. Salvano (Sue) | 657 3012 |
| E3, AOM | D. Woodberry (David) | 657 3011 |
| E2, System Support | G. Kirby (Gary) | 657 3364 |
| E2, Field Support | N. Salameh (Nabil) | 657 3367 |
| E1, AOM | A. Toskic (Andrew) | 657 3415 |
| E1 | L. Maricak (Liza) | 657 3054 |
| STO2, Field Support | G. Ashton (Graeme) | 657 3053 |
| STO2, System Support | R. Perrott (Rod) | 657 3038 |
| STO1, Field Support | P. Zelensky (Peter) | 657 3363 |
| STO1, System Support | S. Berkley (Stan) | 657 3366 |
| STO1, AOM | M. Rhoderick (Michael) | 657 3382 |

ARE-11

| | | |
|---|---|---|
| E4, ARE-11 Co-ord | G. Williams (Geoff) | 657 3088 |
| E3, Field Support | I. McCallum (Ian) | 657 3055 |
| E3, System Support | J. Chen (John) | 657 3495 |
| E3, ARE-11 Consultant | M. Missiha (Bill) | 657 3056 |
| E3, ARE-11 Consultant | E. Parker (Ed) | 657 3059 |
| E2, System Support | C. Havlin (Charles) | 657 3050 |
| E2, Field Support | M. O'Loughlin (Michael) | 657 3052 |
| STO2, System Support | J. Pietka (John) | 657 3036 |
| STO2, Field Support | R. Strickleton (Rick) | 657 3042 |
| STO2, ARE | G. Peel (George) | 657 3383 |
| STO1, System Support | S. Harries (Steve) | 657 3006 |
| STO1, Field Support | D. Otter (Doug) | 657 3496 |

SPECIAL PROJECTS SYSTEMS SUPPORT

| | | |
|---|---|---|
| STO2 | G. Peel (George) | 657 3383 |
| STO1 | M. Rhoderick (Michael) | 657 3382 |

WORKS CO-ORDINATION

| | | |
|---|---|---|
| STO1 | J. Kaye (John) | 657 3008 |
| TO2 | J. Flatley (John) | 657 3007 |

CENTRAL PARTS STORE, 54 Wellington Street Collingwood

| | | |
|---|---|---|
| Sen FMO | J. Wright (John) | 419 9199 |
| FMO | S. Leydon (Sandra) | |

February 1985

Doc Id 0025J